WORLD PETROLEUM

JUNE 1960

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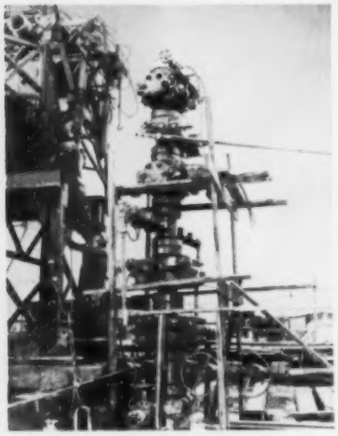
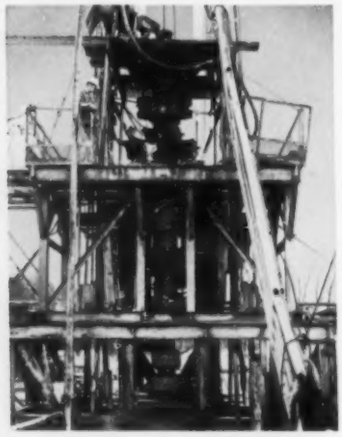
table of contents page 3

Cameron controls safeguarded this tricky re-work operation — sanding was encountered at 13,500 ft. and the production string had to be pulled. A surface pressure of 8,700 psi was safely held in check.



This stack of Cameron preventers helped regain control after a blowout occurred while coming out of the hole.



This well caught fire, after a casing failure, fortunately bridged and extinguished itself — once again under control it required extensive re-work before drilling could continue.

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QUESTION 1. In 1959, 28 plants in the United States were producing ethylene—the hydrocarbon intermediate which is way ahead of all others both in quantity produced and in versatility. What was the estimated total U. S. capacity for this valuable chemical in 1959?

a ——— 3.7 Billion Pounds

b ——— 4.9 Billion Pounds

c ——— 5.6 Billion Pounds

d ——— 6.4 Billion Pounds

QUESTION 2. How many of the U. S. ethylene plants were designed, engineered and constructed by the Lummus Company?

	PLANTS	CAPACITY
a	3	.4 Billion lbs.
b	5	.6 Billion lbs.
c	7	.8 Billion lbs.
d	9	1.0 Billion lbs.

ANSWERS: 1. *The answer is (c)—5.6 billion pounds, according to Chemical Week's Report on Ethylene, May 9, 1959.*

2. *Again the answer is (c). In the last 10 years Lummus has 7 Ethylene plants to its credit in the U. S. alone with a combined capacity of .8 billion lbs. Lummus' world-wide total is 13, with a combined capacity of over a billion pounds per year. For ethylene projects, or any type of process plant, call on Lummus' 50 years of experience in design, engineering and construction.*

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World Petroleum

THE MANAGEMENT PUBLICATION OF THE INTERNATIONAL PETROLEUM INDUSTRY

CONTENTS

4 Washington Pipeline, *by Joseph B. Huttlinger*

10 London Letter, *by Cecil W. Wood*

16 Canadian Notes

18 Latin American Oil News

20 Processing Review, *by William C. Uhl*

35 Editorial—A Self-Defeating Proposal

37 Oil-Company Earnings and Finance Point up Profit-Margin Squeeze, *by Dillard Spriggs*

40 Crude Starts Flowing Through Rotterdam-Rhine Pipeline, *by H. J. Slingenberg and G. R. E. Einsel*

43 Hassi Mesaoud—Saharan Oil Giant, *by C. de Lapparent and P. Albert*

47 Levy Sees "An Oil Age"

49 Progress at Milford Haven, *by Cecil W. Wood*

56 The World's First Quintuple Producer

62 Petrochemical Carbon Disulfide from Methane, *by Peter W. Sherwood*

70 New Sealed Bearing Unveiled

74 Oil Company Staff Changes

80 International News and Notes

88 Advertisers' Index

THIS MONTH'S COVER

Geologist and assistant, working in the Andean jungle of western Venezuela for Richmond Exploration Co., pause to orient themselves in the Venezuelan jungle. This photograph is reproduced through the courtesy of C. R. Lyman, editor of *The Bulletin*, house organ for Standard Oil Co. of California.

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Washington

by Joseph B. Huttlinger

Majors Deny TBA Charges

Major oil companies now have had their day in the continuing series of charges and denials that they force their dealers to handle company-sponsored brands of tires, batteries and accessories.

Last December, a parade of 27 auto parts wholesalers and gasoline dealers cited scores of cases where major oil companies "coerced" their dealers to handle only the approved TBA.

On April 27 and 29, major oil companies had a chance to deny the charges. Nine of the companies appeared to present affidavits and sworn testimony denying a total of about 40 specific charges. In addition, Esso Standard Division of Humble Oil and Refining Co. denied forcing certain dealers to go on a commission basis and Standard Oil Co. (Calif.) defended its new three-year lease as "usual" and "businesslike." Officials said 97% of the dealers have accepted it. Thirteen other oil companies sent in letters, but did not appear and most of the letters denied the charges. Another nine companies did not reply to an invitation to appear.

At the close of the hearing, Roosevelt said some of the charges of pressure seemed to stand up, but that others were knocked down. "The overall problem is just as serious" in the TBA field, he said. "If injury is being done to a minority it is wrong." Roosevelt wants passage of a bill to forbid oil refiners from accepting commissions on sales of TBA products at their gasoline stations.

National Fuel Policy Sought

The American coal industry appears likely to make some progress in its battle for legislation looking toward the creation of a national fuels policy. The progress, if it comes, will be over the spirited opposition of the bulk of the American oil and gas industries which fear "end use" controls to get a boost from any policy study.

While the coal forces may not achieve a study group of eight members of the House and eight of the Senate, they are almost certain to win at least a Senate committee study of the matter, with or without legislation. A coal-backed resolution wants the group to study "optional allocation" of fuels among other things. Oil and gas men see in this a save our oil and gas campaign.

Frank C. Porter, president of the American Petroleum Institute, told Congress that the new study is "unnecessary" and "duplicating" of other studies now underway. A number of other oil industry spokesmen agree with him. But Harry C. Jones, president of the Texas Independent Producers and Royalty Owners Association, said oil should not consider coal "a mortal enemy." If a study is to be made, he feels, oil and gas should cooperate with it.

While there are some who feel that any study is likely to back up coal's contention that oil and gas should be saved for "higher uses" because they are relatively scarce, others feel differently. Thus, some oil and gas executives believe that a valid argument can be made that there is no sense in saving the "best and cheapest" fuels and using the least desirable.

Pipeline

Import Program Likely to Stay

U. S. crude oil producers are seeking changes in the level of imports of crude oil and oil products amid signs they are not likely to get very far. Apparently with the aim of "holding his feet to the fire" producer officials lined up a meeting with Secretary of the Interior Fred A. Seaton in May. At about 1,700,000 b/d, imports are very high in relationship to demand the producer officials believe, and should be shaved back.

The government feels that imports are not the cause of the U. S. industry's problems of too much crude oil and too much refined products. Captain M. V. Carson, Jr., oil import administrator, explains that if imports were shut off entirely, the U. S. industry would still have a problem of too much oil.

Mr. Carson has advised the producers to look to rising sales of natural gas, a flattening of demand, and the use of coal as other causes of today's surplus, as well as overproduction.

Coal producers are putting the heat on the administration for cutting back residual oil import levels. Coal men want the residual quotas on a three month basis, instead of six; they feel this will block a situation as recently happened when a large part of quota for the first half of this year was used up early, and a supplemental quota had to be given to meet demands.

All signs are that the import program will remain in effect for years to come. U. S. officials explain it will continue "as long as it is needed."

Minor Jameson, executive vice president of the Independent Petroleum Association of America, feels that the "main" cause of today's surplus problem is that total demand for crude oil at refineries today is hardly greater than it was four or five years ago. "This flattening out of demand," he feels, "is the real thing the industry must adjust to.

No Gas Treaty Needed

Chairman Jerome Kuykendall of the Federal Power Commission sees no need of a U. S.-Canada treaty to spur on the flow of natural gas across the border.

"It may not be easy" to achieve such an agreement, he feels, adding that if the two countries "continue doing business with each other in an honorable and trustworthy manner, permanent and stable policies will probably evolve anyway."

He feels that "existing law provides the machinery" by which the FPC can authorize imports and exports of gas. The FPC, he says, is using this power to the benefit of persons on both sides of the border.

Kuykendall ticked off examples of cross-border projects that have been approved starting with the first major one—that of Pacific Northwest Pipeline Corp., approved in 1954 and 1955 to lay a line and import Canadian gas. Latest action came in Canadian approval of export of gas to the U. S. in additional projects.

Longest LPG Pipeline

Construction of the longest LP-gas pipeline in the country, which will carry the gas for half the railroad rate, began in April and was to be finished by the end of the year, according to officials of Mid-America Pipeline Co., Tulsa, Okla.

Robert E. Thomas, president, director and chief executive officer of the firm, said the 1,749-mile line of six, eight and ten inches will be completed to McPherson, Kan., by October. It will be continued

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to St. Paul, Minn., and to Madison, Wisc., in two branches by the end of the year. The line starts at Eunice, N. M.

Williams Brothers Co., Tulsa, Okla., is in charge of engineering and construction. Cost is $70,893,250. Initial capacity is 50,000 b/d, which can be increased to 86,000 b/d by additional pumps. Initial plans call for 18 pump stations with a total of 14,700 hp. The work also includes construction of 510 miles of gathering lines and 58 miles of delivery spurs, for a total of 2,317 miles.

Most of the officers of Mid-America are officers or directors of Missouri-Kansas-Texas Railroad Co. it is explained. Mr. Thomas is chairman of the executive committee and a director of MKT.

Dual Bookkeeping Approved

A natural gas company may keep two sets of books, one for the Federal Power Commission and another for the Internal Revenue Service, the IRS has ruled.

The ruling came in the case of a gas company, subject to the FPC, which capitalized "large amounts of interest, taxes and intangible drilling and development expenses" under the FPC's Uniform System of Accounts. When it came to income taxes, the company deducted the amounts.

The IRS said:

"Held, in computing earnings and profits of a corporation, interest and taxes which were deducted for federal income tax purposes, rather than capitalized at the election of the taxpayer under section 266 of the Internal Revenue Code of 1954, and intangible drilling costs which were deducted as expenses at the taxpayer's option under section 263 (c) of the code, are deductible in computing earnings and profits, in determining the amounts available for distribution, in the same year and in the same manner as they are allowable as deductions in the computation of taxable income. For this purpose, it is immaterial how such items are recorded on the books of the corporation."

Capital Spending to Rise

The U. S. petroleum refining industry expects to spend $2.93 billion on new plant and equipment during 1960, which is about 20% more than the $2,491 billion in 1959.

The figures come from a report on business spending plans based on a survey of business firms by the U. S. Department of Commerce and the Securities and Exchange Commission. The figures apply to plants turning out products of petroleum and coal, but is mostly petroleum refineries.

The spending for the first quarter of 1960 is put at $559 million and for the second quarter at $708 million. These figures compare with year earlier figures of $518 million and $619 million respectively.

Oil is holding its own in the industrial expansion, the figures show, for total business spending for new plant and equipment is expected to rise only 14% to $37.02 billion, about the level of 1957.

New FPC Members

President Eisenhower has named as new members of the FPC, which regulates natural gas pipe lines and electric power companies: 1. Thomas J. Donegan, age 53, a member of the Subversive Activities Control Board, to the term of five years which starts next June 22; and 2. Paul A. Sweeney, age 64, who is first assistant in the office of legal counsel of the U. S. Department of Justice. Mr. Sweeney was named to the term which expires June 22, 1963, a term vacated by the death of Commissioner Hussey.

The naming of the two men came as a complete surprise to gas and electric industry officials. It had been widely expected that an attorney from the U. S. Senate Commerce Committee staff would be named to the full five year term and a man close to the gas industry to the Hussey post.

Mr. Donegan would replace Commissioner William R. Connole whose term comes to an end June 22, 1960. The President told a press conference April 27 that "I can find a better man" than Connole. That, he said, is why he is not renaming him. He gave no other reason.

With a presidential election to be held in November, the Democratic leadership may be inclined to stall on the nominations in hopes of putting a Democrat in the White House next year. Then, the new president could name his own men to the FPC.

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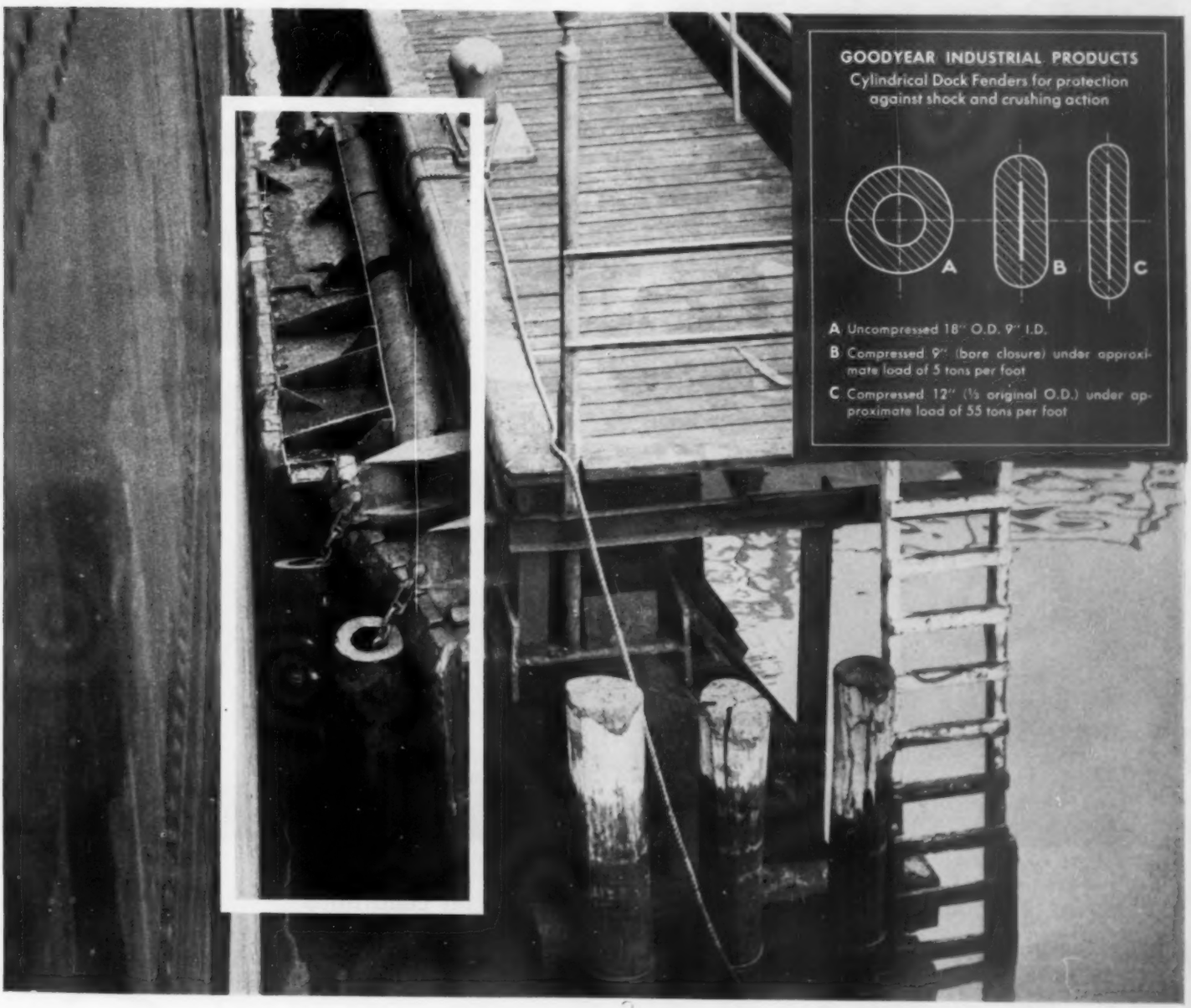
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UK Consumption Rises In 1959

UK deliveries of petroleum products into consumption (excluding bunkers for ships in foreign trade) rose 17.5% last year to 36,514,044 (long) tons from 31,065,629 tons in 1958, according to information independently collated for the UK Petroleum Industry Advisory Committee. The rise in 1958 over 1957 was 6,281,061 tons (25.3%) but Suez complications affected this comparison.

While motor spirit deliveries rose 7.6%, the outstanding rise once again was the 30.5% for fuel oil (excluding refinery consumption)—from 10,581,488 tons to 13,811,874 tons. For black oils as a whole (including diesel engine road fuel and refinery consumption) the increase was 4,139,199 tons (22.8%), to 22,289,672 from 18,150,473 tons and accounting for 61.1% of total deliveries last year against 58.4% in 1958. Deliveries are summarized in the accompanying table.

The analyses show the ever-increasing popularity of premium motor fuels and, among commercial users, the growing preference for diesel vehicles. Other interesting points include the rise in demand for propane and butane, and especially the reflection of the petroleum-chemical industry in the 52.7% rise in deliveries of "other products," largely chemical feedstocks.

UK Consumption of Petroleum Products

	1959	1958	1959	1958
	1,000 long tons		Per cent	
Aviation fuels	1,629	1,565	4.5	5.0
Motor spirit(a)	7,124	6,624	19.5	21.3
Industrial(b) and white spirits	363	333	1.0	1.1
Kerosine	1,572	1,569	4.3	5.1
DE&R fuel(c)	2,276	2,049	6.2	6.6
Gas/diesel oils	3,123	2,987	8.6	9.6
Fuel oil(d)	16,890	13,114	46.3	42.2
Lubricating oil and grease	928	872	2.5	2.8
Paraffin wax and scale	51	52	0.1	0.2
Propane and butane	125	89	0.3	0.3
Bitumen	991	868	2.7	2.8
Other products	1,442	944	4.0	3.0
Total	36,514	31,066	100.0	100.0

Notes: (a) Includes motor benzole. (b) Includes industrial benzole. (c) Diesel engine road fuel. (d) Includes refinery consumption: 1959—3,078,518 tons; 1958—2,531,830 tons.

BHC Plant Expansion

The £4 million, 13,000 ton/year phenol plant at Grangemouth of British Hydrocarbon Chemicals Ltd. went onstream at the end of March, and was working satisfactorily as to its design rating and expected product quality. This is the first plant of its type to be built in the UK.

New equipment has also been installed for bulk handling by road or rail, and for acetone by tanker. Special insulated stainless steel tanks with heating coils are used for the phenol, which has an unusually high melting point corresponding with its purity. With the plant in full operation, surplus capacity for

General view of new cumene-phenol unit at British Hydrocarbon Chemicals Ltd. in Grangemouth.

cumene production is available, and a major export order is already being met by regular shipments to Europe. It is expected that a large proportion of the phenol made will be used by Distillers in its plastic material manufacture.

Stone & Webster Engineering Ltd. were the main construction contractors, with the cumene unit built to Scientific Design (USA) specifications. The second unit, for converting cumene to phenol, is based on a process developed by Distillers Co. Ltd. some years ago. Cumene is oxidized to its hydroperoxide, which is then split into phenol and acetone by Distillers' modern continuous process.

Contracts for engineering design, procurement of materials and equipment, and construction for the three new petroleum-chemical plants to be built at Grangemouth at a cost of £5 million have been awarded as follows: butadiene plant—Fluor Engineering & Construction Co. Ltd, ethylene dichloride plant —The Lummus Co. Ltd.; and methanol plant—Chemical Construction (Great Britain) Ltd.

ICI Plans for Severnside

Imperial Chemical Industries' plans for its new 1,000-acre Severnside site will include a 100,000 ton/year ammonia plant and associated units to make urea and fertilizers. These will cost upward of £10 million and production is expected to start in 1963. This is the second project to be announced, the first being ethylene oxide and derivatives plants costing £5 million.

WITCO to Make Latices

There will be a new name to add to the list of UK petrochemical producers, one long well-known in the general chemical and paint fields. This is Witco Chemical Co. Ltd., affiliate of Witco Chemical Co. Inc. (USA), which is to build a plant in the Midlands with an initial capacity of a 8 million lb/year to produce a complete line of butadiene-styrene synthetic rubber latices, high styrene latices, nitrile latices, and other acrylic types. Completion is scheduled during 1961. Witco is presently compounding synthetic and natural latices at a plant at Droitwich, Lancs.

British Geon Expansion

British Geon Ltd., joint plastics offshoot of Distillers (55%) and the US concern, B. F. Goodrich Chemical Co., has begun work on a £2 million extension of its polyvinyl chloride plant at Barry (South Wales). The addition in capacity was not stated, but it has been responsibly suggested that 50% may be added to current potential, generally regarded as around 30,000 tons a year.

A link has also been suggested with the earlier announcement by British Hydrocarbon Chemicals (50% Distillers) of new plant projects, one of which is for the production of ethylene dichloride. At present all UK PVC is based on acetylene, but it is possible that British Geon may have decided to deposit from this to some degree and to follow US practice in basing production largely on ethylene dichloride.

More Methanol from Heysham

Although a new 30,000 ton/yr methanol plant at Heysham (Lancs.) only began producing a few months ago, Imperial Chemical Industries has already decided on an extension to make a further 45,000 tons/year. This should be completed during 1962.

Lubes without Metallic Additives

Representing a radical departure from past practice, and a breakaway for the first time from the general use of organo-metallic compounds, Shell has replaced its range of X-100 motor oils by two new multigrade X-100 oils, a 10W/30 and a 20W/40 grade. This breakaway, exclusive to Shell, is made possible by the development of a combination of dispersant, anti-oxidant and anti-wear additives which, unlike previous additive formulations, completely avoids the use of metallic compounds and thus the normal build-up of harmful engine deposits.

The UK is the first market in which this new organic formulation is being used, and it follows several years of development and some 1.5 million miles of fleet trials in 10 countries. These have fully supported the claims of less power loss as the inevitable combustion chamber deposits build up, and in engines with appreciable mileage on ordinary oils, a recovery of power up to 50% as the metallic deposits are removed. Complete oil change naturally gives the speediest benefit but the new multigrades are fully compatible with the present oils in use.

Regent Oil has also introduced new lubricants—"Advanced Havoline" oils, in five viscosity grades and two multigrades. These retain the use of organo-metallic additives and the latest formulation is claimed to: (a) contain new oxidation inhibitors, (b) have the highest extreme-pressure additive treatment, (c) the highest detergency level, (d) exceptional and viscosity index, and (e) superior ability to adhere to metal surfaces. An entirely new chemical is said to be used to prevent sludge formation.

M. R. Bridgeman, CBE.

J. M. Pattinson, CBE.

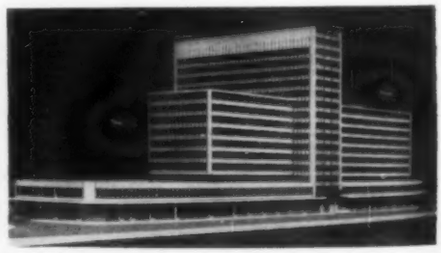
New British Petroleum Chairman

The Hon. M. R. Bridgeman, CBE, has been appointed chairman of The British Petroleum Co. on July 1, when Sir Neville Gas relinquishes this post on reaching the normal retiring age. Except for the war years, Mr. Bridgeman's career has been entirely with the company, which he joined in 1920 with a distinguished academic record. He became a managing director in 1956 and deputy chairman in 1957. During the war he held such posts as petroleum adviser to the Ministry of Economic Warfare, joint Secretary of the Oil Control Board, and principal assistant secretary of the Petroleum Division of the Ministry of Fuel and Power.

On the same date J. M. Pattinson, CBE, becomes a deputy chairman after service with the company since 1922, being general manager in Iran from 1934 to 1945.

New Esso Headquarters

A new London head office is planned for Esso Petroleum Co. on an island site with a 500-ft frontage to Victoria Street. About 235,000 square feet of accommodation will be provided in a 16-story tower and two 9-story wings. Tower and west wing will be ready for use by autumn 1961 and the east wing by spring 1963.

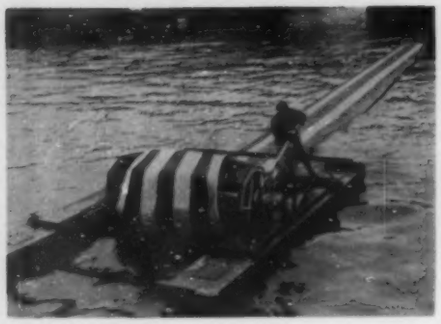


Model of new London headquarters office planned by Esso Petroleum.

SWANSEA HARBOUR SOUTH WALES

This ingenious new fire-fighting float, the "BP Firemaster", was designed by BP. It can deliver 3,100 gallons of water a minute at a pressure of 100 pounds per square inch, or alternatively 12,500 gallons of foam a minute.

BP



THAMES TEST OF THE "DRACONE" was made in a special demonstration recently before Port of London Authority officials by Dracone Operations Ltd. to show stability, flexibility, and maneouverability of a 35-ton Dracone flexible barge. Cargo was kerosine, loaded at Esso Petroleum's Purfleet terminal. In view here, Dracone is wound back on its pontoon for easier transportation after unloading cargo of kerosine.

Shell UK Purchases in 1959

The Royal Dutch/Shell group placed orders with British industry last year worth £43½ million, comparing with £39 million in 1958, and these totals exclude the many millions spent on construction, repair and victualling its tanker fleet and on major plant construction contracts in the UK. The above 1959 figure represents 34% of the total of £117.3 million reported by the Oil Companies Materials Association for orders for materials and equipment (excluding tankers) placed in the UK by oil companies.

Appointments

ZEB MAYHEW (USA) and **S. WILSON** (USA) have been appointed directors of Anglo-Ecuadorian Oilfields, Ltd.

N. F. PATTERSON, Monsanto Chemicals' director in charge of engineering and purchasing, has assumed the executive responsibilities formerly held by **Sir WILLIAM GARRETT.** Sir William has relinquished these to devote more time to his other interests but remains a director.

N. L. FALCON, chief geologist of British Petroleum Co., and **Dr. R. HOLROYD,** a deputy chairman of Imperial Chemical Industries, have been elected Fellows of the Royal Society.

A. C. BALL, production manager of Hayward Tyler Ltd., and **A. E. GILBERT,** commercial manager and chief accountant, have been made directors.

US Equipment Links

Head Wrightson & Co. Ltd. has signed an agreement with the Belco industrial division of Bogue Electric Manufacturing Co., Paterson, N. J., under which Head Wrightson Processes Ltd. has the sole right, exclusive of the North American continent, to engineer and build water softening plant incorporating Belco designs and patents.

Mechans Ltd., of Scotstown, Glasgow, announced a significant extension of its tank building and general engineering activities through a recent agreement with Union Tank Car Co. of Chicago. The latter has purchased a substantial interest in Mechans from Hossely Bridge & Thomas Piggott Ltd. and henceforth will share its ownership. Mechans will continue as an independent enterprise but will have the benefit of Union's patents in general engineering.

British Equipment News

P. G. Engineering Ltd., of Stockton-on-Tees and a member of the Power-Gas group, issues "Recent Production Data and Costs for Hydrogen over a Range of Pressures and Purities." This reviews the technical developments which have taken place in hydrogen production methods since 1955 and, in particular, the experience and results from plants installed by the company. These include high purity steam PG/Hercules hydrocarbon reformers operated at low pressure and one of the first partial oxidation units for high pressure production of synthesis gas from oil.

Head Wrightson Processes Ltd. has formed an industrial furnace division at its London offices (20-24 Old Street, E.C.1) in order to meet its expanding operations in this field and to strengthen the services offered to the petroleum and chemical industries.

Mechanical seals made by *Flexibox Ltd.* are being used on the glands of 147 pumps at British Petroleum Co.'s new Montreal refinery. This figure, in general, covers all process pumps plus other rotary equipment, including boiler feed water pumps.

The Fisher Governor Co., Ltd., of Rochester (Kent) and a member of the Elliott-Automation group, has recently supplied 41 automatic control valves for use in AGIP's gas field at Cortemaggiore, Italy. Gas pressures may be as high as 2,000 psi and these will be reduced and maintained at a constant 850 psi.

An improved, more powerful 4-cylinder car diesel produced by *Perkins Engines Ltd.* is making its world debut at the British Exhibition in New York in June. This is the P4/203, which develops 62 bhp at 3,000 rpm—3 bhp more than the P4 engine now operating in many US taxicabs—and it has a slightly larger bore.

Leyland Motors Ltd. has introduced a single drive double-reduction axle of completely new design for its heavy-duty and super heavy-duty trucks. A hypoid bevel gear train is used for the first reduction and a compact driving head provides only a slight reduction in gearing. Thus an exceptionally large driving pinion can be used, whereas in a normal single-reduction axle this component is usually the weakest unit.

New Publications

"Fuel Abstracts and Current Titles"—The Institute of Fuel (18 Devonshire Street, Portland Place, London, W.1) starts publication of a new and much-desired monthly summary of world literature on all technical and scientific aspects of fuel usage, replacing in an improved form the "Fuel Abstracts" published by the Department of Scientific and Industrial Research until the end of 1958. The improvement lies in the fact that the new series gives titles and sources of papers in advance of the abstracts, thereby catering for those who desire the most speedy reference to current technical awareness. Annual subscriptions for this new service, including postage, are £12 12s. ($36.00), or specially printed for card-mounting £15 15s. ($44.00).

"The Story of Kuwait:" a most interesting and profusely illustrated account of the history of Kuwait, the progress of Kuwait Oil Co. throughout the years, and of current oil field and other projects. Its 80 pages also bring out clearly the considerable developments that have been and are being undertaken under the wise guidance and encouragement of its Ruler. Copies are available from the company at Burgan House, Wigmore Street, London W.1.

"ICI Titanium:" With the issue of Part 2 "Physical and Mechanical Properties" (60 pages), and Part 4 "Fabrication" (28 pages), Imperial Chemical Industries' metals division completes publication of what is virtually a four-volume textbook of valuable information on the properties, corrosion resistance, fabrication, and weight tables of wrought titanium and its alloys. The charts and diagrams are commendably clear. Copies are available free of charge from ICI Metals Division, P. O. Box 216, Birmingham 6, England.

Large New Falmouth Dock

One of the early uses for the new Queen Elizabeth Dock at Falmouth was for the post sea trial examination of the largest British built and owned tanker, BP's "British Queen," capable of carrying about 50,000 tons of crude oil.

This dock is claimed to have a capacity in excess of the largest tanker capable of berthing at any existing British oil installation. One of its most interesting features is the use of 34 remotely controlled bilge blocks, 17 each side and 33 ft apart, especially designed by Silbey, Cox & Co. Ltd. Block movements are effected by penumatic and hydraulic equipment made by Holman Brothers Ltd., and the blocks can be positioned accurately under water by a precise electrical and signalling system made by Maxam Power Ltd., an associated company. Thus, the need for ship shoring is eliminated and the ship's side and the dock are left unhampered.

Unique Fire-Fighting Float

"A little craft with a big job; not a ship but an oddity. There's nothing in the world like it." This is how S. H. Dobson, BP Tanker Co.'s superintendent engineer described the unique fire-fighting float, the "BP Firemaster," now installed for fire protection in Queen's dock, Swansea, South Wales, where each year some 3 million tons of crude oil is received for the BP Llandarcy refinery.

Built in Wales for BP refinery (Llandarcy) Ltd., this novel craft was designed by Mr. Dobson in collaboration with Merryweather & Sons Ltd. and R. S. Hayes (Pembroke Dock) Ltd., two firms with long experience in the fields of fire-fighting equipment and shipbuilding respectively.

Its main features are two pontoons, each 60 ft long and 14 ft wide, and spaced 8 ft apart. These are joined together at deck level and at their bases by elliptical tubes to form a "catamaran." The pontoons are surmounted by four tubular supports which form a 40 ft tower on which two platforms and a control cabin are mounted.

Fitted on the platforms and atop the cabin are nine 4-inch fire-fighting nozzles for spraying water or foam. These monitors are so arranged that seven can be used in any single direction simultaneously.

Two Merryweather pumping sets on board enable the float to deliver 3,100 gpm of water at 100 psi, or alternatively, 12,500 gpm of foam.

Each pumping set consists of a two-stage turbine fire and salvage pump direct-coupled to a W. H. Dorman & Co. 6QA, 6-cylinder in-line, four-stroke, water-cooled, oil engine. Normally aspirated, this engine has a continuous rating ranging from 112 bhp at 800 rpm to 239 bhp at 1,800 rpm.

Harbormaster Ltd. supplied the propulsion units for the float, which are driven by Dorman 6KUD diesel engines rated at 140 bhp at 1,550 rpm.

Tidewater Buys Land at Holyhead

Tidewater Oil Co. (England) Ltd. has purchased about 82 acres of land at the foot of Holyhead mountain in Anglesey (north Wales), which it has had under option for a considerable time. No information on any further decision on development has been disclosed as yet by the USA parent firm.

The land meanwhile continues to be farmed. As far back as late 1958, Tidewater and Shell Petroleum were given permission for a large bulk oil terminal at Holyhead.

New Dow Office in Germany

Opening of a marketing office in Frankfurt, Germany, was announced by Deutsche Dow Chemie GmbH. The new office will handle the marketing of Dow chemicals, plastics and agricultural products in Germany, Austria and Switzerland. Actual sales in these countries will be processed as before through appointed sales representatives.

James C. Tucker has been appointed manager of the office at Deutsche Dow Chemie GmbH, Weissfrauenstrasse 3, Frankfurt a/M, Germany.

SINCLAIR

GRANTED U. S. PATENT ON FIRST MOTOR OIL WITH NICKEL

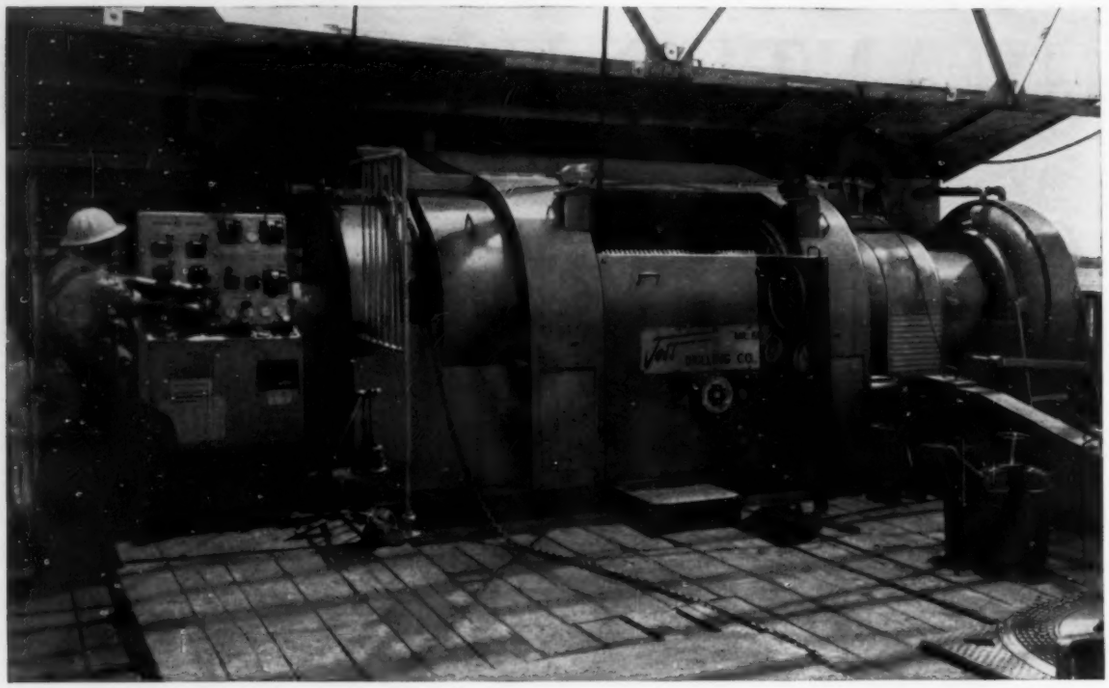
Sinclair has just been granted a U. S. patent for Sinclair Triple X Multi-Grade Motor Oil with nickel. This new oil, developed by Sinclair Research Laboratories Inc., offers anti-wear protection available in no other motor oil.

The nickel in new Sinclair Triple X literally *armor-plates* an engine against wear, rust and corrosion. Wherever there is pressure or load in the engine, molecules of nickel form a tough, protective plating of smooth metal.

Today, only Sinclair's Triple X Multi-Grade Motor Oil contains nickel. For further information write to Lubrication Sales Department, Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR REFINING COMPANY
600 FIFTH AVENUE, NEW YORK 20, N. Y.

Making hole faster — Gardner-Denver's new power-packed "2100" drawworks



2100 horsepower	One-piece construction
Air-actuated controls	Ample braking power
Eight hoisting speeds	Four rotary speeds—two reverse

Word is getting around that the smooth-running Gardner-Denver "2100" handles bigger loads at higher speeds . . . has the power and stamina of a giant. If your next well is a deep one—15,000 feet on down—get the facts on the "2100". Call your Gardner-Denver petroleum industry specialist.

WHAT'S NEW AT GARDNER-DENVER?

Matched component equipment for the Gardner-Denver "2100" drawworks: crown block, traveling block, swivel, rotary table, compound. Also a new 1500 hp drawworks and matched component equipment.

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Ave., Toronto 16, Ontario
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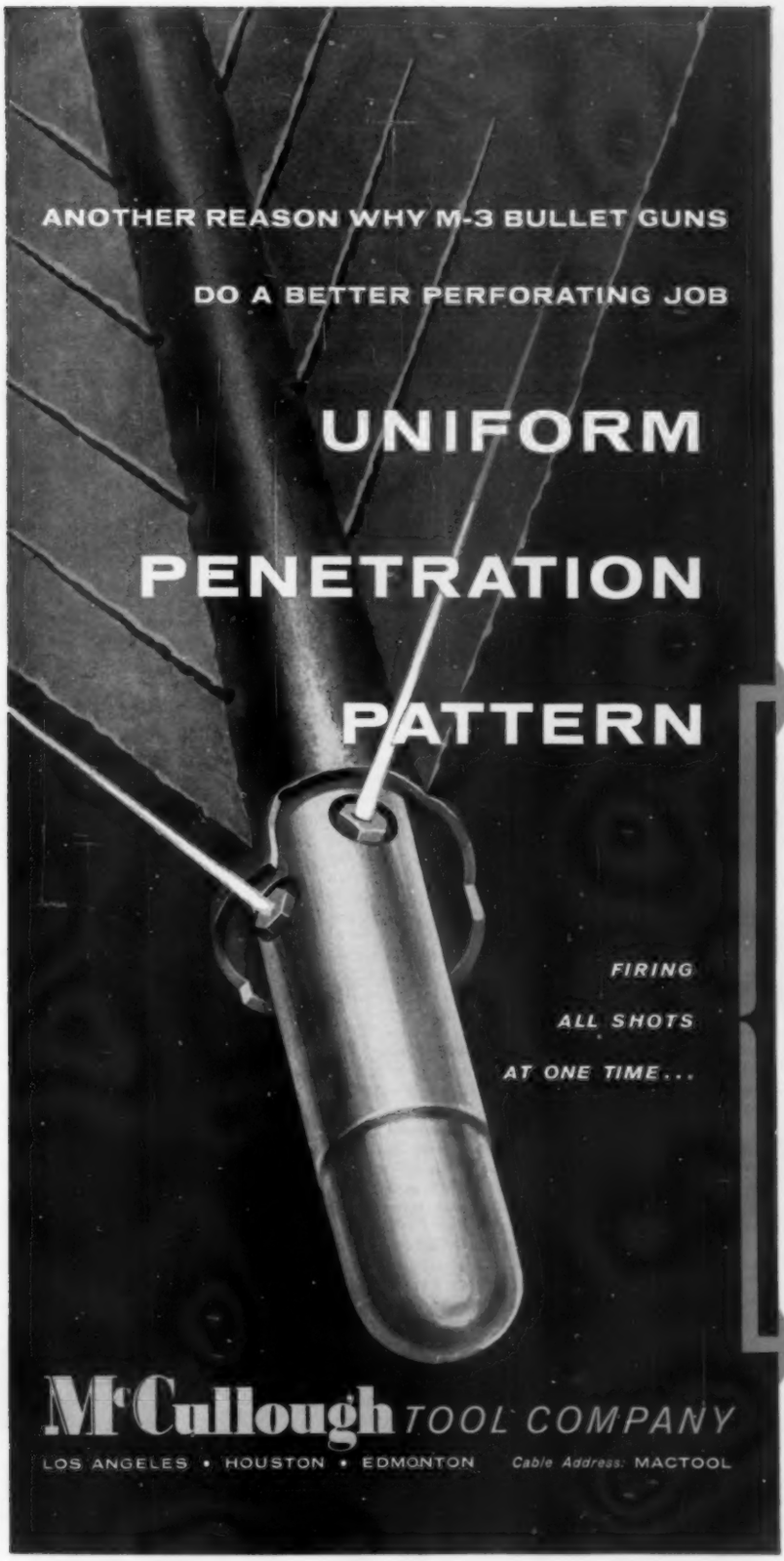
Petroleum Offices: Casper, Cleveland, Columbus, Corpus Christi, Dallas, Denver, Durango, Edmonton, Ellinwood, Evansville, Houston, Huntington, Jackson, Kansas City, Lafayette, Los Angeles, Mexico City, New Orleans, Odessa, Oklahoma City, Pittsburgh, San Francisco, Shreveport, St. Louis, Tulsa, Wichita, Winnipeg

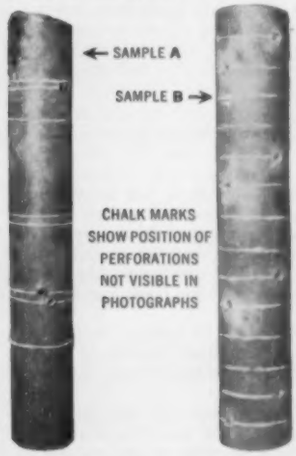


Deep, evenly spaced perforations that *uniformly* cover the productive zone – assure you of the most effective perforating job – and that's what you get when you shoot for production with McCullough M-3 Bullet Guns.

An M-3 Gun fires all shots at one time while the gun is motionless in the casing. Thus, perforations are the exact pattern of the chambers in the gun – in any shot density desired.

Combine McCullough's precise depth measurements with deep, evenly spaced perforations covering the *entire* pay zone and you get maximum drainage from formation to well bore – best possible production.

prevents bunching of shots in one small area in pay zone, giving insufficient coverage – prevents scattering of shots over a wide area, possibly missing the pay zone entirely. Sample A (actual photo of pipe recovered from well) shows the erratic shot pattern produced by a gun firing one shot at a time. As each shot is fired the upward thrust of released gases causes the gun to dance up and down.



eliminates the danger of possible pipe damage or failure. Too many perforations in one spot or in a coupling can cause pipe to part if it is in severe tension. Sample B is an actual example of six shots per foot fired by an M-3 Bullet Gun. Note the uniformity of shot pattern – no danger here of seriously weakening your casing, and you get the most productive perforating job possible.

CANADIAN NOTES

Hydrocarbon Line Planned

Alberta may soon have an integrated gathering system throughout the foothills area, and a 16-inch transmission line to a Lake Michigan port, to handle the Province's growing surplus of liquid hydrocarbons, says James A. Scott, president of Pembina Pipe Line Ltd. Calgary, and two wholly-owned subsidiaries, Foothills Pipe Lines Ltd. and Westalta Products Pipe Line Ltd.

Engineering studies call for a products pipe line that would include some 900 miles of a full-scale gathering system in Alberta, from the Berland River gas field approximately 200 miles northwest of Edmonton to the Waterton Lakes gas field in the southwest corner of the Province.

A lateral line would take the products to the Saskatchewan border, probably near Burstall, Sask., then southeast to the North Dakota border, through North Dakota, Minnesota, and through Wisconsin to a deep-water port on Lake Michigan. The transmission line from the Alberta border to the Great Lakes market area would be approximately 1,300 miles in length.

The pipe line would cost approximately $150 million, of which about $42 million would be in Pembina's own liquid hydrocarbons gathering and transmission system in Alberta.

The Pembina-Producers, composed of several major Alberta producers, have shown a production of liquid hydrocarbons of at least 92,000 b/d as soon as additional gas export gets underway, probably by 1962. The liquid hydrocarbons, propane, butanes and condensate, are removed from natural gas before it can be transported and marketed. Practically all of the new production for gas export will come from wet gas fields in the foothills area of Alberta, gas fields rich in the liquid hydrocarbons. Alberta's present production of the hydrocarbons is about 12,000 b/d.

There are some 20 wet gas fields from Berland River to Waterton earmarked for the production of natural gas. These fields will have processing plants picking up the liquid hydrocarbons, carrying them to the main gathering line running north and south, then to the main transmission line leading to the Great Lakes market. The system would make a steady, cheaply transported source of supply for provincial markets, since the products would be available anywhere along the 900-mile gathering and transmission system within Alberta.

Some twelve engineering proposals were examined in detail by the Pembina-Producers Research Group. The present plan represents the best solution on existing production market data. The 16-in line, with varying wall thickness, would be to API specifications and would be purchased through Canadian sources. It would be designed to carry something over 65,000 b/d initially, and would be designed to work to a maximum pressure of 1,200 psi. By adding to the original 12 pump stations, the line could handle up to 160,000 b/d.

The hydrocarbons would be carried in a mixed stream to their destination and if required by the market, would be separated before delivery into component parts.

Mr. Scott stated that his company had spent substantial sums of money in the past two years in an effort to find practical solutions to the problem of marketing Alberta's vast natural gas by-products. Complete surveys on economics; feasibility and markets were made for twelve separate pipe line proposals. Some of these included a proposal to send liquid hydrogen sulfide commingled with liquid hydrocarbons in a 14-inch line to the west coast by a southern route; to send the same products to the west coast by a northern Yellowhead route; to send liquid hydrogen sulfide in one line and liquid hydrocarbons in a second line to the west coast; to use the two-line system to send the products to the Great Lakes; to commingle the products in a 14-inch line to the Great Lakes, and finally the present proposal.

Mr. Scott pointed out that many other schemes were studied. In an effort to find a practical way of pipe-lining sulfur, for instance, Pembina looked at the possibilities of transporting it as a slurry in water; as hydrogen disulfide; as liquid sulfur dioxide, and in the form of sulfuric acid, and in other compounds.

Currently, large sums are being spent by Pembina Pipe Line Ltd. and some of the major gas producers, in research to determine the feasibility of sending elemental sulfur as a slurry in the liquid hydrocarbons stream. Research is being carried out by the University of Alberta, and the Colorado School of Mines Research Foundation Inc.

"Every effort is being made," Mr. Scott said, "to find a practical way of transporting at least some of our surplus sulfur so that it can compete in larger markets. Only a pipe line solution offers a chance of keeping transportation costs low enough to make this possible."

Meanwhile, Pembina is going ahead with its plans to gather and transmit surplus liquid hydrocarbons by pipe line to the Great Lakes industrial area. Mr. Scott estimated that if all permits necessary were to be granted during 1960, construction could start in early 1961.

"As a Canadian company, we are happy to have had the opportunity of working with several major gas producers in solving the surplus problem of Alberta's liquid hydrocarbons. We are convinced that ours is the only possible and practical solution, and is one that will result in increased royalties to the province; greater return to the gas producers; and substantial ownership in the system by Albertans and Canadians as a whole."

Some petroleum officials contend that the proposed line will get tough competition from the new 2,300-mile LPG line now under construction from New Mexico via Texas, Kansas, Minnesota and Wisconsin by Mid-American Pipeline Co. This line is expected to be competed by December.

Others point out that because the proposed 1,300-mile line from Alberta to the Great Lakes industrial area will carry condensate as its main by-product, the marketing conditions could be such that the Mid-American and Pembina lines will actually complement each other.

The Pembina Group's studies show that the Great Lakes industrial area, centered in Chicago, has a refining capacity of 580,000 b/d which is growing every year and requires large quantities of liquid hydrocarbons for refinery raw material. Alberta's surplus hydrocarbons could be easily absorbed into this market without replacing any market for Alberta petroleum crude.

The studies point out that the Chicago-Milwaukee area has never used western Canadian petroleum. They point out the manufacturing industry of the area has an immediate market of 10 million people, with access to 23 million people by competitive waterborne transportation.

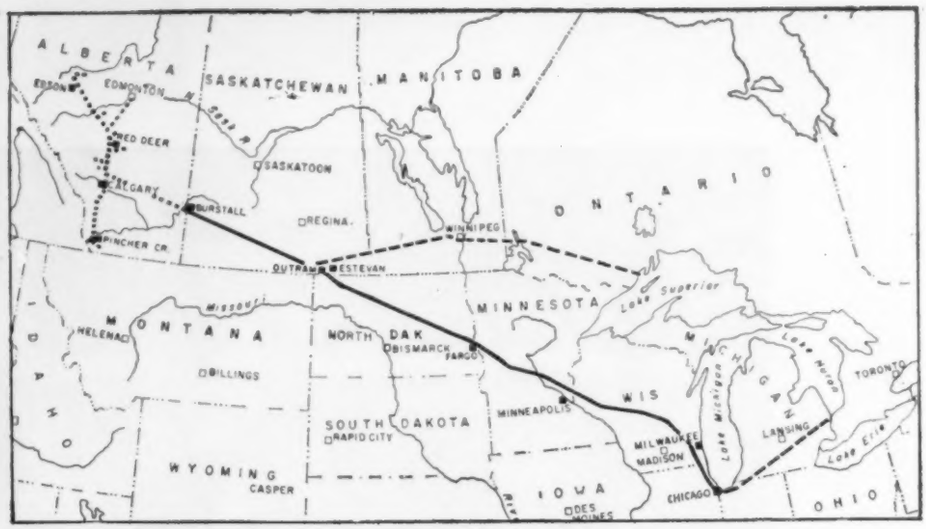
An outlet on the Great Lakes, through water freight on the St. Lawrence Seaway, would also give Alberta liquid hydrocarbons a chance to tap the eastern Canadian markets.

Pembina officials, aware that a surplus problem would arise, began studies in 1957 to find an economic method of utilizing the forseeable staggering quantities of hydrocarbons in Alberta.

When Mr. Scott was asked if keeping the liquid hydrocarbons in Alberta would force petrochemical plants to locate in the procince, he cited the group's study of Oklahoma.

"Alberta and Oklahoma may be compared as to their production and utilization of hydrocarbons. Alberta has a population of 1¼ million and Oklahoma has 2¼ million. Both areas have the same handicaps: comparatively small population with consequent low consumption of finished products, and a landlocked position with consequent high freight rates. This makes it competitively uneconomical to ship finished products by rail, and the only answer is to transport the raw materials by the cheaper pipe line method to areas of heavy population or with access to cheap water transportation. Thus, Oklahoma, which presently produces approximately 71,000 barrels of liquid hydrocarbons a day, has only one petrochemical plant using products located in the state. It exports the majority of its liquid hydrocarbons by pipeline."

In the light of Pembina's quantity studies, Pembina experts realized Alberta would have to have over six times the number of Alberta's present petrochemical plants to utilize even the first year of production resulting from the new export of natural gas to the USA, and Albertans would have to have a percapita consumption of petrochemical products ten times that of the USA.



Route of proposed hydrocarbons line from Alberta gas fields to Great Lakes area. Solid line is main transmission line; dashed line is proposed extension to Lake Superior; and dotted line is gathering system in foothills.

New Appointments

KENNETH A. WEST has been appointed a vice president of Canadian Oil Companies, Ltd. Dr. West, formerly manufacturing manager, will continue to be responsible for the administration of the manufacturing department. He also assumes the added responsibilities of directing the company's supply and transportation and purchasing departments.

Dr. K. A. West

Dr. JOSEPH SPIVAK, of Calgary, had been appointed vice president of Mobil Oil of Canada Ltd. **PAAVO PUUMALA,** formerly with Mobil in Roswell, New Mex., becomes chief Mobil geologist in Calgary. **PETER FLEMING,** formerly production superintendent in Calgary, has been appointed chief engineer.

J. H. MANNING has been appointed zone exploration manager of the newly established Edmonton exploration zone of The British American Oil Co. Ltd.

(*Continued on page* 18)

...his bridge to a new world

The river bank once marked the boundary of this boy's life. But soon this bridge will open a new world to him. He'll meet new people, new ideas—and new opportunities.

Petroleum products power the giant machines used in building this bridge and in laying the roads that will reach out from either side. It will power the vehicles that will travel them.

All through Asia, Africa and the lands of the Pacific, the steady growth of industry and commerce calls for more oil. Here Standard-Vacuum is working to meet this demand—by searching for new sources of oil, drilling for it, transporting and refining it, and delivering the finished petroleum products when and where they are needed.

STANDARD-VACUUM OIL COMPANY **POWERS PROGRESS**

White Plains, New York

LATIN AMERICAN OIL NEWS

Conoco Crude to Panama

The D. K. Ludwig interests have signed a contract with Continental Oil Co. to supply crude to a new refinery under construction at Las Minas in Panama. The refinery is Refineria Panama S. A. H. J. Polk, vice president and chief of construction for Compania Refineria y Petroquimica de Panama SA came to Porto Bello in March to survey a proposed site for this new plant. The board of directors of Ultramar is yet to ratify an agreement with the Shaheen interests to buy 51% of the Petroquimica stock. Ultramar has been guaranteed a loan of up to $26 million at 4% by the British treasury, reported $40,000 contract for drainage has been let, with the work to start soon.

New Guatemalan Wildcat

Four USA oil companies, associated in a major Guatemalan drilling venture, have announced a shift of drilling sites. The Ohio Oil Co. of Guatemala, operator and spokesman for the group, reported that high-pressure and corrosive sulfur-water flow and periodic losses of circulation had caused the drilling pipe to part three times in eight months. The most recent break occurred on March 20 when 38 joints of pipe weighing 25,000 lb dropped 2,400 ft to the bottom of the well, making recovery economically unfeasible. The Chinaja jungle well, located 110 miles back in the interior, had reached a depth of 10,806 ft.

An alternate drilling site has been chosen. The new area is 17 miles northwest of the previous well in the Chinaja jungle, according to H. D. Hoopman, resident manager of The Ohio Oil Co. of Guatemala. The Chinaja jungle hole did produce the first sample of oil ever found in Guatemala, in July of 1959, but not of sufficient quantity for commercial production. Associated with Ohio in the venture are Amerada Petroleum Corp. of Guatemala, Continental Oil Co. of Guatemala, and Union Oil Co. of California.

Test Brazil's Amazon Basin

Estimated crude production in Brazil during February and March was 75,000 b/d; rigs operating, 62. The 69 teams in January included nine surface geological, 36 exploratory, 10 gravimetric, and 14 seismographic. Under production test in the Amazon basin is well AM6-AM at Autas Mirim on Careiro Island, where oil was discovered last December at 3,578 ft—first indication of oil in the Monte Alegre formation, considered of good permeability. The eighth wildcat in this area was spudded in February. Ten wells were then drilling in the Amazon basin. Also in February wildcats were spudded at Sao Jose, in Alagoas-Sergipe area; and at Camp Grande, in the south basin.

At Mataripe, Landulpho Alves refinery is now processing 32,000 b/d. Cubatao refinery during 1959 processed a million barrels of Bahia crude per month —to be raised to 1,500,000 this year. The refinery's asphalt plant processed 3,840 b/d of Boscan crude when in operation; solid asphalt output was 145,000 tons, and liquid 27,000 tons, during the year—with gross value of sales at 500 million cruzeiros. Output of the fertilizer plant was 48,000 tons valued at 145 million crs. A 318-ton ethylene storage tank was installed during 1959. By June 1961 three new petrochemical units are to be added at the Duque de Caxias refinery, where a 260 psi tank was installed during March for propane storage.

In March, Petrobras took delivery of the 33,000 ton "Presidente Washington Luis," last of four vessels ordered from Verolme United Shipyards, Rotterdam.

Venezuela Tightens Control

The new 100% government-owned national oil company, in operation on April 19, is called Corporacion Venezolana de Petroleos. With authority to go into all phases of oil operations from exploration and production through transportation and marketing, it has the right also to acquire complete or partial ownership of established companies. Speculation exists as to whether the government will take over most of the private companies' oil leases when they start expiring around 1983.

Argentine Crude to Jump

Production of crude in Argentina by Standard Oil Co. (Indiana) will be increased to 25,000 b/d from 4,500 b/d now that a new pipeline to the coast has been completed—with further expansion expected. The company's capital expenditures will rise 10% during 1960, to about $300 million—half for domestic and foreign crude production. The company's 1959 expenditures were nearly $270 million.

Uruguayan Refinery Runs

Crude runs to stills in Uruguayan refineries totaled 8,254,000 bbl during 1959, on the basis of the first 11 months as reported by ANCAP.

Labor Peace for Venezuela

Five more companies have followed the lead of the country's "Big Three" (Creole, Mene Grande, and Shell of Venezuela) by signing a three-year labor contract—following five months of talks with Fedepetrol during which a crippling strike threatened. Package settlement includes 10% to 12% wage increase and additional fringe benefits, to cost the Venezuelan oil industry in excess of $100 million.

Colombia's Five Discoveries

The 201 wells drilled in Colombia during 1959 had total footage of 1,140,522; compared with 169 wells the previous year totaling 963,504 ft. Some 50 exploratory wells were completed for 312,214 ft during 1959; five found oil, 45 were dry. Of the 151 development wells with combined footage of 828,308, oil accounted for 105; two were gassers, 12 dry, one observation, and 31 water-injection. Texas Petroleum Co. opened two new fields with exploratory wells at Baul and Magdalene; Shell Condor discovered Crystalina; International Petroleum opened up Cachira field; and Colombian Petroleum Co. found oil in Zenon-1, in a well officially completed in 1960.

Peru Reports for 1959

Final figures for all companies indicate Peru produced 17,733,311 bbl (48,584 b/d) of crude during 1959. Natural-gasoline output (including propane, butane, and hexane) came to 1,069,755 bbl (2,931 b/d). Refinery runs of crude during the year totaled 15,510,527 bbl (4,250 b/d). Product exports during 1959 totaled 3,123,438 bbl (of which 1,159,270 bbl was diesel oil). Exports of crude totaled 2,110,118 bbl (of which 1,022,795 went to England, 580,649 to Argentina, and 506,674 to Brazil). Product imports during the year totaled 2,575,491 bbl (of which 1,586,628 was residual).

Final figures on crude production in Peru during 1959, by companies and fields, are as follows:

Company	*Total bbl*
International Petroleum Co.:	
Brea-Parinas	8,223,956
Lobitos fields	7,535,040
Empresa Petrolera Fiscal	928,516
Belco Petroleum Corp. (formerly Petrolera Peruana)	78,870
Petrolera Amotape	72,480
Peruvian Pacific Petroleum Co.	27,769
Ganso Azul Co.	804,175
Cia. Oriente (Maquia field)	55,041
1959 total	17,725,847
1958 total	18,732,136

Brazil's Output

Crude production during 1959 totaled 23,589,872 bbl (64,630 b/d), according to the National Petroleum Council. Output of refined products was led by fuel oil at 26,786,807 bbl and regular gasoline at 18,233,064 bbl.

Chile's 1959 Operations

Final figures for the year indicate crude output by Chile's ENAP during 1959 totaled 1,021,988.9 cubic meters (2,800 daily). Total refinery runs came to 1,373,695 cubic meters (of which 945,297 was domestic and 428,398 imported crude). Total footage drilled amounted to 189,090 meters. Ninety wells were completed during the year, of which 41 were producers.

Venezuelan Oil Find

Venezuelan Sun Oil Co. has confirmed discovery of oil in Lake Maracaibo on its joint concession with Venezuelan Atlantic Refining Co., Texaco-Seaboard Inc., and Pan American Petroleum Corp. Completion of SLGX 12-4 confirmed the group's first discovery on Block 12 found earlier with the successful completion of SLGX 12-3. Both dual producers, each of the wells tested about 5,000 b/d.

Venezuelan Sun also has revealed completion of a stepout, SVS-39, which significantly extends the proved production area on Block 1, Lake Maracaibo. Producing oil from two different pay zones, SVS-39 tested 5,000 b/d. Block 1 is held jointly by the same group.

Give up in Colombia

After failure in four deep tests drilled during 1958-59 on three farmouts, Colombian Sun (with its two partners, Pure Oil and United Carbon) is withdrawing from Colombian exploration. Neither are the partners exercising their option to take up a half-interest in acreage now held by Jersey Standard and Mobil Oil affiliates. Application for 14 offshore permits also have been withdrawn by the partners.

Canadian Notes

(*Continued from page* 16)

R. N. TAYLOR has been appointed zone exploration manager, Regina, replacing Mr. Manning there.

J. G. STOUT has been appointed personal assistant to the president of Shell Oil Co. of Canada. He succeeds A. E. Ashurst who has been named manager of the Division Services organization in Edmonton.

Pure-Woodley Merger

Pure Oil Co. has acquired Woodley Petroleum Co. properties, including oil and gas wells in the USA and Canada.

Oil and Gas Rise Seen

An all-time peak in Canadian oil and gas exploration has been forecast by John W. Buckley, president of Canada Southern Petroleum Ltd. Basing his predictions on recent oil and gas finds in Western Canada and the new favorable gas export policy of the Canadian government, Mr. Buckley estimated that Canadian crude oil production will be substantially increased over the next five years. He also estimated that natural gas sales will increase by 1965 to a level approximately three times present volume or about 27% of total hydrocarbon production within the country.

Referring to the recent natural gas discovery on Canada's Southern Celibeta structure in the Northwest Territories by the Home-Signal group, Mr. Buckley declared that the discovery well, which yielded gas through a ½-inch choke at rates approximating 8 mmcf/d, "further confirms the belief that this area (extending) from the northeastern section of British Columbia into the Northwest Territories will develop into one of Canada's major gas provinces."

A related development of great future significance, he added, (was the recently announced plan of West Coast Transmission to add a 300-mile main line, 30 inches in diameter, connecting the Pacific Northwest with the prolific gas fields at Kotcho Lake and Petitot River, as well as the area of the Canada Southern Celibeta discovery to the north. Completion of the planned gathering system, Mr. Buckley pointed out, will provide a ready market for export of natural gas to meet the rapidly growing demands of the Pacific northwest.

Canada Southern recently expanded its Canadian concessions through acquisition of 1,500,000 acres in the McKenzie River delta area, lying in the northwestern section of the Northwest Territories, as well as 25% interest in an additional 8,000,000 acres located in the neighboring Arctic Islands area. Canada Southern's partners in the latter venture are Tidewater, Cree Oil and Clark Refining. This brings Canada Southern's gross land holdings to 13,600,000 acres and its net holdings to 4,700,000 acres.

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by William C. Uhl
Processing Editor

Highlights of the month—the high compression piston engine is here to stay, the backbone of tomorrow's refinery will be flexible catalytic reforming, further data on improved Fluid coking, aluminum has a place in refinery service

High compression piston engines for automobiles will continue to be built for many years to come, according to Wheeler G. Lovell of Ethyl Corp.'s Detroit research laboratories.

As a result, the petroleum industry will have to keep on solving the combustion problems characteristic of these powerplants, he said. Mr. Lovell's remarks were made during his 1960 James Clayton lecture at the Institution of Mechanical Engineers in London. He cited such continuing problems as knock at various throttle openings, precombustion reactions, deposit formation, surface ignition, and incomplete burning, as well as such new problems as the formation of smog ingredients.

Many chemical developments have been of significant help in finding the solution, among them the various additive materials such as tetra ethyl lead, methylcyclopentanedienyl manganese tricarbonyl, tertiary butyl acetate, and the phosphorus compounds. The future will bring increased knowledge of the chemistry of side reactions during combustion. Petroleum scientists are going to learn much more about why reactions take place rather than merely learning the empirical relationships. He pointed out that saturated gasolines above 100 octane must consist of "tailor-made" molecules. The future will continue to bring changes in refining processes to produce the kinds of molecules needed.

Supporting Mr. Lovell's thesis that high compression piston engines are here to stay is a paper given by Ethyl Corp.'s John S. Wintringham before the Lead Industries Association meeting in St. Louis this spring discussing future automotive powerplants and the gasoline market.

Mr. Wintringham described the several recent developments in automotive powerplants and their characteristics—gas turbine, free piston engine, battery power, fuel cell, modified Stirling engine, and the NSU (or Curtiss-Wright) engine. Some of these have been discussed in these columns in recent months.

After carefully weighing the advantages and disadvantages of these various power sources at their present state of development, Mr. Wintringham concluded that it does not appear that any alternate powerplant is likely to replace the conventional gasoline engine in passenger cars. He pointed out that none of them is competitive to the gasoline engine in all such factors as size, weight, power, flexibility, economy, manufacturing cost, and general convenience as yet. Some of them, however, do have certain attractive potentialities as power sources in other applications.

The motoring public is going to show continually increasing interest in better fuel economy in terms of more miles for its dollar, he said, citing the growth trend in small car sales and import sales in the USA automobile market. He estimated that by the end of 1964, small cars will represent 16.4% of the total passenger car population of 71.4 million. Of these, 3.9 million will be imports and 7.8 million compacts.

Motor gasoline demand during the same time period, however, will also grow in the USA, moving up 17.7% from today's 57 billion gals to 67.1 billion gals in 1964.

The backbone of tomorrow's refinery for production of premium grade gasoline will be flexibly designed catalytic reformers, according to John R. Sabina, Petroleum Chemicals Division, E. I. du Pont de Nemours & Co. in a talk at an American Chemical Society meeting recently. In addition, he stated, alkylation, hydrocracking and isomerization will be used also in increasing degrees, along with new types of antiknock additives, to attain the required gasoline quality level.

Mr. Sabina predicted that the number of automobiles on the road in the USA can be expected to increase from today's 60 million to about 85 million by 1970. Gasoline refiners must plan not only for this 30% increase in USA gasoline consumption over the next ten years, but also for cars having octane requirements of 103.5 and higher as early as 1966.

Flexibility in the catalytic reformer means ability to attain three severity conditions: (1) mild severity to give 90 Research Octane Number with 3 ml/gal TEL, (2) moderate severity to give 95 R.O.N. with 3 ml/gal TEL, and (3) high severity to give 100 R.O.N. with 3 ml/gal TEL.

The additional processes needed for further octane level increases are: (1) severe reformate splitting, (2) alkylation as a substitute for polymerization, (3) pentane isomerization of virgin and reformate fractions, (4) hexane-heptane isomerization of virgin and reformate fractions, and (5) catalytic hydrogenation and severe reforming of heavy catalytically cracked naphthas.

Mr. Sabina echoed the comments of Mr. Lovell regarding the kinds of problems to be solved. He was also in generally complete agreement in respect to trends in additives, citing one additional new material as being particularly interesting for the highly aromatic fuels—tetra methyl lead.

Further information on the new Model II Fluid Coking design were reported by Esso Research and Engineering Co. in a paper at the mid-year refining meeting of the American Petroleum Institute in Detroit a few weeks ago.

Aimed at improved economics through lower investments, Model II Fluid Coking in the capacity range of 10,000 b/sd has an onsite plant investment of $230/bbl, of fresh feed, about 35% lower than the $350/bbl investment represented by earlier models. Operating costs associated with the improved design are approximately 25% and utility investments approximately 65% lower than previous typical designs. This has been accomplisher with no sacrifice in product yields or qualities. Depending upon the value of coke-free products, returns may range around 60% or more if coke is valued at $5/ton, and well above 90% after taxes when coke is valued at $15/ton.

Among design changes which contribute to these economies are the following: (1) simplified process flow, (2) reduction in overall silhouette of the coker, (3) streamlining of design with improvement in heat transfer, (4) improved feed injection and burner design, (5) optional use of a waste gas turbine to drive the air blower, and (6) several changes aimed specifically at reducing turnaround time.

Many refiners regard aluminum as a metal suitable only in the kitchen for pots and pans. Not so Sinclair Refining Co., whose engineers reported interesting success with aluminum in certain exchanger and condenser tube applications in a paper presented at the Detroit meeting of the API Refining Division.

Aluminum is not the highly unpredictable metal some people believe it to be, the Sinclair men said. There are some locations where it will serve successfully and there are a few where it will fail rapidly. Citing their own company's experience, they said one refinery now has 27 aluminum bundles in service.

Four of these bundles have been in service over 6 years in a Fluid catalytic cracking unit, 14 have been in a catalytic reformer more than 5½ years, and one has been in service over 8 years in a diethanolamine polymerization feed treater. A number of these bundles have never been pulled for inspection and have had only minor cleaning on the water side.

In another refinery, an aluminum condenser bundle was recently retired which had been in operation for more than 4 years in hydrogen sulfide-ammonia stripping service where steel tubes had failed within 20 weeks or less, admiralty tubes failed in 5½ weeks, and 5% chromium tubes failed in 17½ weeks.

Tube failures in aluminum have occurred from both the water and the hydrocarbon side. Deposits were partly responsible for the failures, although velocity effect had caused thinning of some tubes and vibration has caused cutting of others at baffle locations. A maximum temperature limitation of 300 F is suggested, as is a maximum chloride concentration of 50 ppm on the hydrocarbon side. Trace quantities of mercury, copper, and other heavy metals can cause failure. Where possible, prior to use, testing is recommended in both the cooling water and a representative hydrocarbon stream.

What's New in Processing Plants

Shell Oil Co. will construct a $12.8 million, 20,000 b/d refinery in Singapore. No information as to site or completion date was disclosed.

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The Sicilian government has authorized the construction of a 52,000 b/d refinery at Milazzo, near Messina, by Raffineria Siciliana Olii Minerali SpA (a subsidiary of SAROM).

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Dansk Veedol, Tidewater Oil Co.'s Danish subsidiary, has awarded contracts to Foster Wheeler Ltd. and Soc. Fives-Penhoet for building of Denmark's first refinery, a 20,000 b/d plant at Kalundborg, scheduled for completion by September, 1961. Dansk Veedol plans capital expenditures of about $24.3 million in Scandinavia during next two years, including marketing facilities.

• • •

AGIP Mineraria (an ENI subsidiary) is negotiating with the Sudanese government for construction of a refinery at Port Sudan to cost about $8.5 million. The Italian State-owned ENI was recently granted an 8,500 sq km concession on Sudan's Red Sea coast. The refinery would operate on imported crude.

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Gewerkschaft Erdoel-Raffinerie Emsland has put on stream a 4,700 b/d UOP Unifiner-Platformer at Lingen, West Germany.

• • •

American Oil Co. will build three new major units at Texas City, replacing six existing units and adding slightly to overall capacity. Planned are: a new 150,000 b/d combination crude still (which will be the world's largest), a 47,600 b/d (fresh feed) catalytic cracking unit, and a 14,600 b/d alkylation unit which will include butane splitting and isomerization. Contracts will be awarded in the near future.

• • •

(*Continued on page 22*)

The oilman plays in a symphony every working day.

His skills blend with the skills of thousands of other experts to help provide the nearly 10,000,000 barrels of oil our nation demands every day. Oil to build, to save lives, to grow food. In oil-hungry tomorrow, the demands will be even greater. He'll meet them. So will you. If you should hear someone speak out against oil—tell him you're an oilman and proud of it. And tell him why.

SHELL OIL COMPANY

El Paso Natural Gas Co. will complete in December a new treating plant using a recently developed Fluor Corp. Ltd. process, the Fluor Solvent CO_2 Removal Process. Fluor has the contract for the $3 million, 100 mmcf/d facility which will be built in Terrell County, west Texas, in the Brown-Bassett field.

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Standard Oil (Ohio) will complete in December a $1.5 million Babcock & Wilcox carbon monoxide boiler at its Lima, Ohio, refinery.

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What's New in Petrochemicals

International Petroleum (Colombia) Ltd. will construct a new $13 million fertilizer plant at Cartagena, on Colombia's northern coast. Daily output will be 300 tons of ammonia and 150 tons of nitric acid.

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The 1,000 ton/day sulfur recovery plant of SNPA at Lacq, France.

The world's largest sulfur recovery unit, a 1,000 long ton/day plant, went on stream this spring at the Lacq, France, installation of Soc. Nationale des Petroles d'Aquitaine (SNPA). Ralph M. Parsons Co. did design, engineering, procurement, and construction supervision in cooperation with S. A. Heurtey Co. of Paris. The unit will be joined by a twin in a few months, to bring total capacity at the Lacq plant to 750 mmcf/d of raw gas and sulfur recovery, to 4,000 ton/day.

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Solar Nitrogen Chemicals Inc., owned jointly by Atlas Powder and Standard Oil (Ohio), will build a $15 million ammonia plant near Joplin, Mo.

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A second ethylene plant for Japan's Mitsubishi Petrochemical Co. Ltd., for 1961 completion, will be built at Yokkaichi. Stone & Webster will be designer, as it was for the first unit, completed in the spring of 1959.

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Japan Synthetic Rubber Co. Ltd. has placed on stream a 25,000 ton/yr butadiene unit, using the Houdry Dehydrogenation Process, at Yokkaichi, Japan.

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Cities Service Refining Corp. has begun construction of a multi-million dollar, 120 million lb/yr ortho-xylene plant at Lake Charles, La. A contract has been entered into with Cosden Petroleum for sale of the plant's production for export through Cosden's exclusive agent, Fallek Chemical Corp. of New York.

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The Ethyl Corp. is now manufacturing its new anti-knock compound for gasoline, tetramethyl lead, at its Baton Rouge, La., plant.

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Cie Francaise des Petroles (Algerie) is expanding its 54,000 b/d crude oil stabilization plant at Hassi Messaoud to 100,000 b/d output. Design and construction is being carried out by Stone & Webster. The plant is 420 miles southwest of Algiers.

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Chemical Construction (G.B.) Ltd. is building a unit to recovery sulfuric acid from refinery sludge for the newly formed Albatros Sulfuric Acid and Chemical Works at Vlaardingen, Netherlands, to operate on sludge from the adjacent Shell refinery. The new company is owned jointly by Albatros Superfosfaatfabrieken N.V., member of the Dutch Salt Group, and Cyprus Mines Corp. of Los Angeles.

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Delhi-Taylor Oil Corp. will complete this month a new 70 million lb/yr ortho-xylene plant at Corpus Christi, Texas. Feedstock is a mixed xylenes stream from a Platformer-Udex unit.

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A major joint venture in manufacture and marketing of petrochemicals to be undertaken by El Paso Natural Gas Co. and Rexall Drug and Chemical Co. will include new plants at Odessa, Texas. The first units to be built, and scheduled for production early in 1962, will manufacture ethylene, propylene, conventional and linear polyethylene, and polypropylene. Initial capacity of the olefin plant will be more than 200 million lb/yr, and combined capacity of the polyolefin plant will be above 150 million lb/yr.

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New Synthetic Jet Lube

A new synthetic lubricating oil for jet planes, which can be stored in tropical regions for five years or longer without deterioration, has been developed by Esso Research and Engineering Co. It is currently being supplied to the military in large quantities.

In developing the new oil, Esso scientists used petroleum raw materials as the initial ingredients although the final product is a synthetic of these materials. Up to now, most other synthetic jet lubes have been based upon chemicals of a vegetable origin.

New Data Processing System

Linear programming for refinery operations, well accounting, tax accounting, sales operations, and many other applications can be handled by the new, fully transistorized RPC-9000 Electronic Data Processing System, latest product of Royal Precision Corp.

The new instrument incorporates many advanced computer design features and provides automatic "in-line" records processing, a new concept in electronic data processing. Data is accepted in random order, and all affected records are up-dated automatically in a single uninterrupted sequence of operations.

The basic system requires only 150 sq ft of floor space with little or no site preparation, no air conditioning, and operates on ordinary house current. The RPC-9000 is available on lease, lease with option to purchase, or purchase. Monthly rental for the basic system is about $2,500. Further information may be obtained from Royal McBee Corp., Port Chester, N. Y.

New Anti-Fouling Agent

A method designed specifically to prevent organic fouling in refinery process equipment has been developed by Nalco Chemical Co. Nalco 262, a chemical stabilizer-dispersant, is said to reduce or eliminate potential deposit-forming materials which foul heat exchangers, furnaces, reboilers, and fractionation columns.

A hydrocarbon-soluble additive, the material is injected into naphtha and gas oil streams ahead of the point where fouling occurs. Nalco said that in one field test, a refinery faced with a monthly shutdown on a furnace on a desulfurizer has now been without downtime due to furnace fouling for more than a year.

Gulf Markets New Lube Oil

Gulf Oil Corp. has begun marketing a new premium grade automotive lubricating oil called Gulfpride Select Single-G, a multiple viscosity, all-season, cold and heat-proof oil meeting SAE 10W, 20W and 30 classifications.

A high detergency, all distillate oil, Single-G is said to meet all lubrication requirements of modern passenger car high compression engines under practically all operating conditions in all seasons and climates in the company's marketing territory.

N.G.A.A. Elects Officers

G. A. McCullough of Phillips Petroleum Co. was elected a vice president of the Natural Gasoline Association of America at its annual meeting in Houston last month.

Other officers who served during the past year were re-elected. They include Charles E. Webber, Sun Oil Co., president; R. W. Heath, Signal Oil and Gas Co., John M. Kindle, Lone Star Producing Co., and Max R. Lents, Reef Corp., vice presidents; William F. Lowe, executive director-treasurer, and Ronald E. Cannon, secretary.

Recognition of their long services to the natural gasoline industry was tendered to five men at the Houston meeting: Joe Miller, Humble Oil & Refining Co.; Sam Hulse, Warren Petroleum Co.; C. C. Clover, American Meter Co.; Larry Dresser, Dresser Engineering Co.; and Harry Fiske, Ingersoll-Rand Co.

Pipe Coating Plant

Tube-Kote Inc., Houston, Texas, is constructing a $300,000 pipe coating plant, its first in Canada. The plant will be located on a 8½-acre site in Edmonton and completion is expected in September.

E. G. Holm, executive vice president and general manager of Tube-Kote states the plant's capacity will provide for the application of corrosion resistant baked-on plastic coating to 16,000 feet of pipe and tubing per day. The facilities will also provide coating to meet corrosion problems in the chemical, petrochemical and refining industries.

General manager of the Canadian plant is Joe H. Williams.

Alberta Trunk Elects

A. G. Bailey, Calgary, has been elected president of the Alberta Gas Trunk Line Co., Ltd. Other directors include B. F. Willson, representing the utility companies; D. C. Jones and J. G. Spratt, representing the producers and processors; N. E. Tanner, representing gas export companies; and R. J. Dinning and G. E. Church, appointees of the Alberta government.

J. C. Mahaffy, Q.C. continues as executive vice president and general manager of the provincial natural gas carrier which transports and feed gas to export companies. J. M. Ballachey is assistant general manager and E. V. Hunt, general superintendent.

Hughenden Plans New Line

Hughenden Pipeline Ltd. has applied to the Alberta Oil and Gas Conservation Board for permission to build a $2 million pipeline from Rimbey, Alta., to an underground reservoir at Hughenden, 100 miles east of Red Deer. The 125-mile line would transport natural-gas byproducts to a British American Oil Co. separation plant now under construction at Rimbey, 40 miles northwest of Red Deer and 80 miles southwest of Edmonton.

B.C. Gas Potential High

Open-flow potential in excess of 100 mmcf/d was measured by Western Natural Gas Co. Inc. (subsidiary of Western Natural Gas, of Texas) in four new gas-producing wells in the Fort Nelson area of northeastern British Columbia. Gas discoveries in this area by Western Natural (formerly Gulf States Oil of Canada) and Pacific Petroleum Ltd. indicate an early construction start in the extension of the Westcoast Transmission pipeline system from the Jedney-Bubbles area to Kotcho Lake and Petitot River and Clark River areas, west and northwest of Fort Nelson.

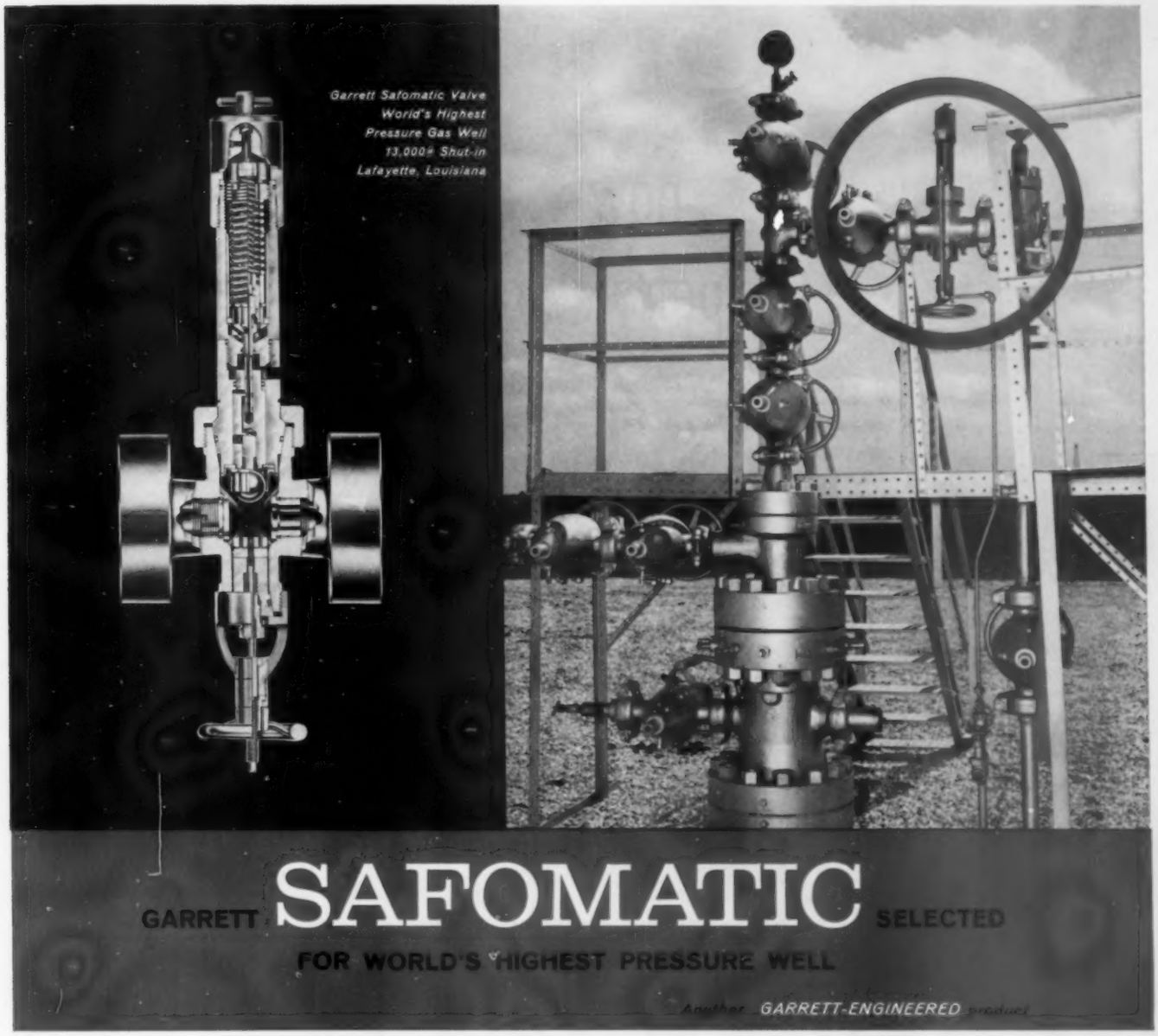
Sell Alberta Gas Properties

Britalta Petroleums Ltd. (Calgary) and Crescent Petroleums Ltd. (Tulsa, Okla.) have sold their interests in the productive Many Islands gas field, with estimated gas reserves of 617 to 800 billion cubic feet in southeastern Alberta, to Saskatchewan Power Corp. Many Islands Pipe Lines Ltd. (Saskatchewan Power subsidiary) now own and operate the 152,000 acres of leases.

The sale price of $20 million (with proceeds believed to be tax-free) should net an estimated $13 million interest over 20 years. Britalta was paid $1 million in cash, plus $2.2 million in 5¼% serials 1961-65 and $6.7 million of 5¼% 20-year bonds underwritten by the Saskatchewan government. Crescent received $1.5 million, and during the next 18 years will be paid $760,000 yearly plus interest.

Canadian Output Rises

The Dominion Bureau of Statistics reports official 1959 production as 184,707,744 bbl (50,624 b/d) of crude, up 11.6% over 1958; and natural-gas output as 433 billion cubic feet, up 28%.



Union Texas Natural Gas Corporation's #1 Adams in South Louisiana recorded a seam straining 13,000 psi shut-in wellhead pressure. Yet, down stream lines and equipment are as safe as if they were connected to a non-flowing well.

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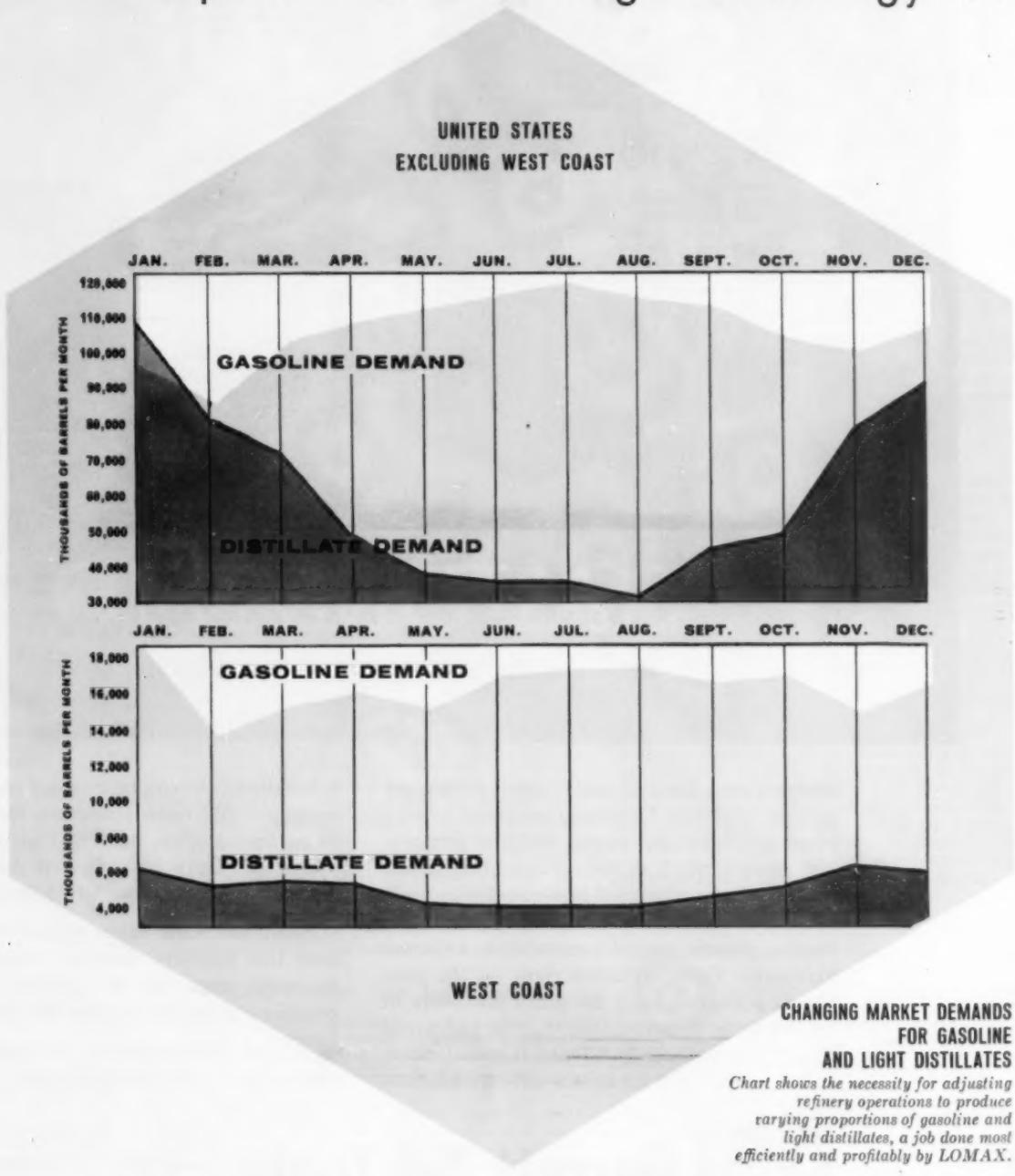

CHANGING MARKET DEMANDS FOR GASOLINE AND LIGHT DISTILLATES

Chart shows the necessity for adjusting refinery operations to produce varying proportions of gasoline and light distillates, a job done most efficiently and profitably by LOMAX.

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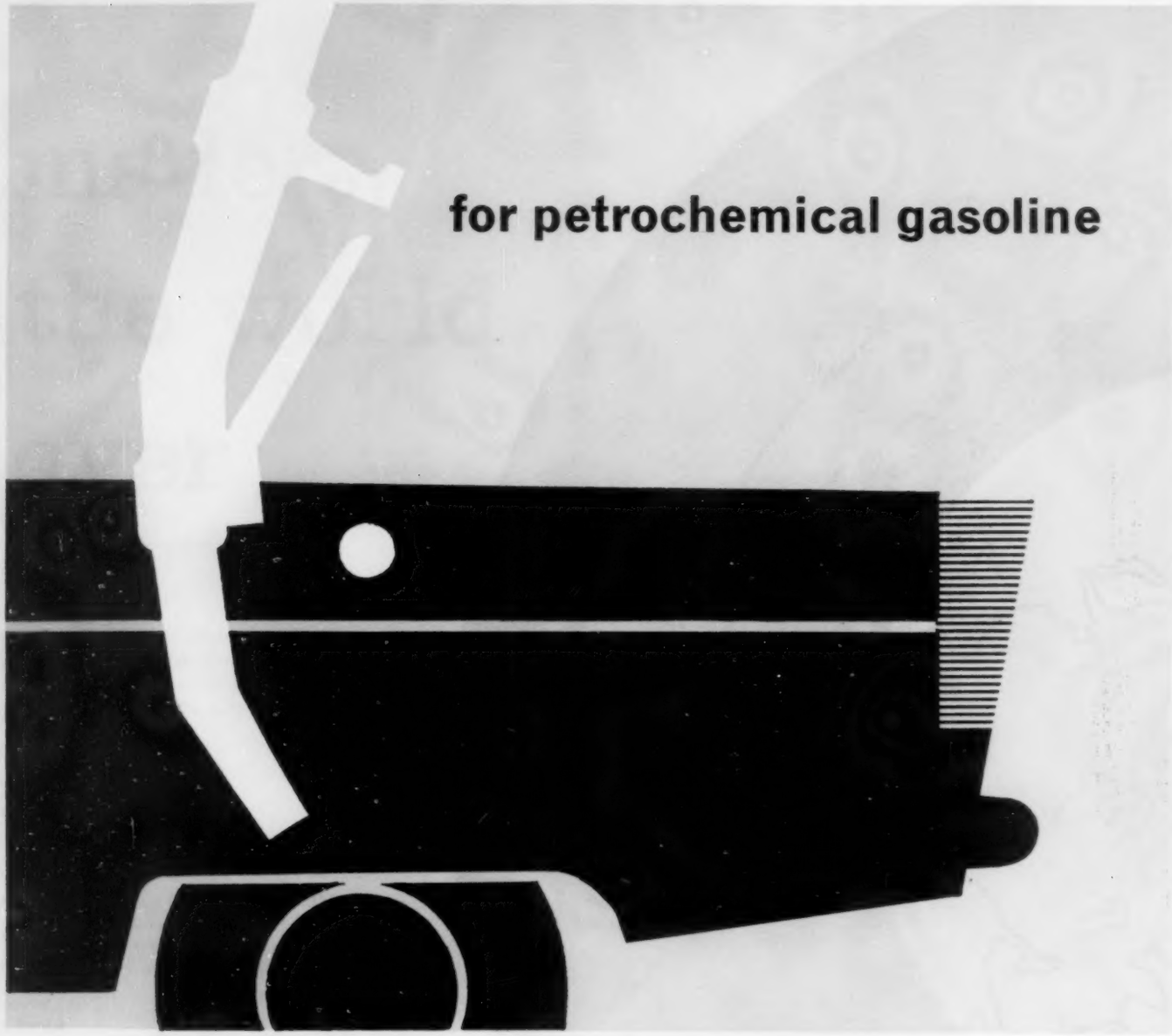

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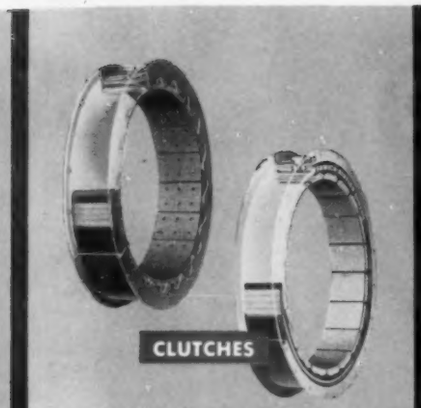

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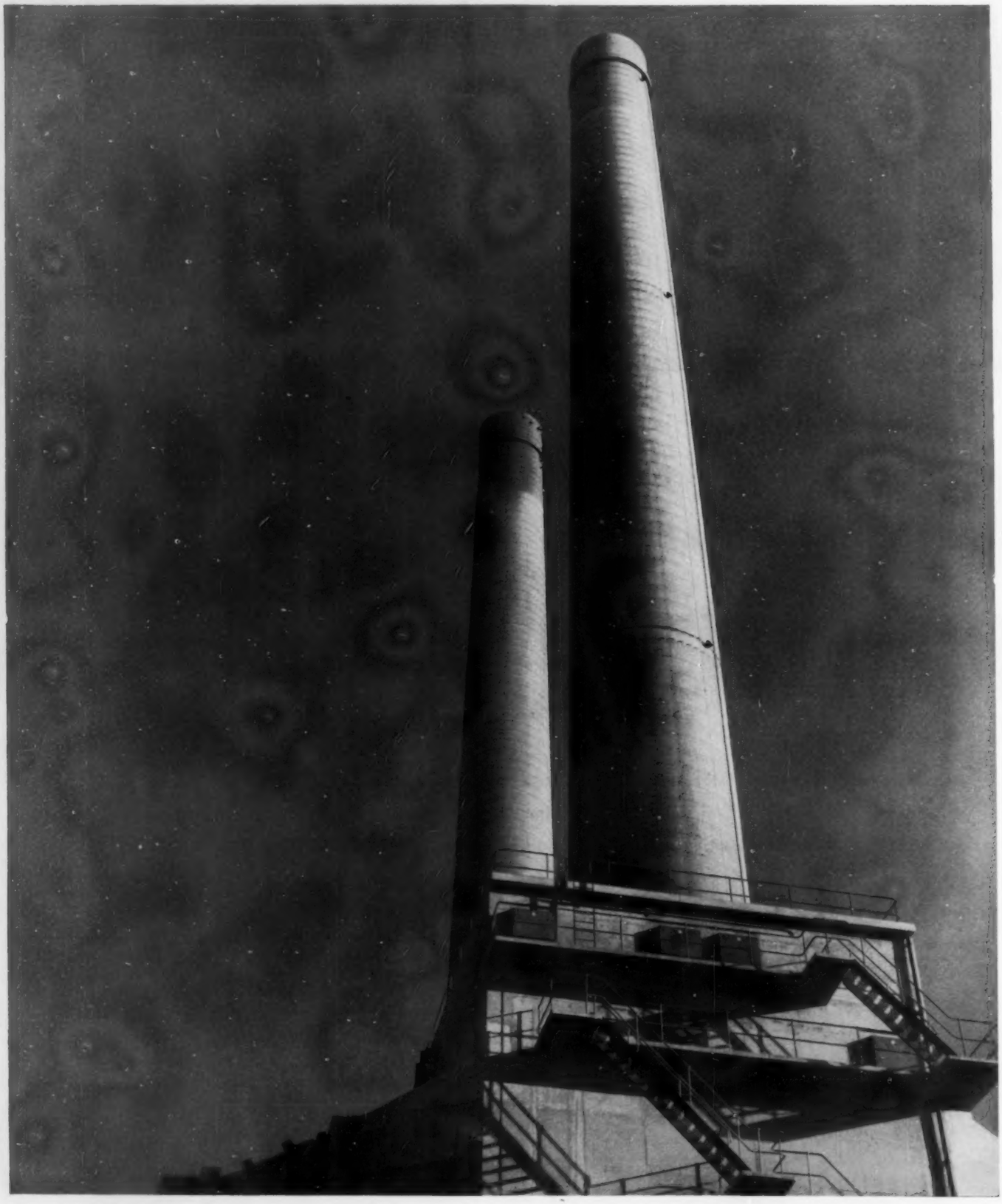

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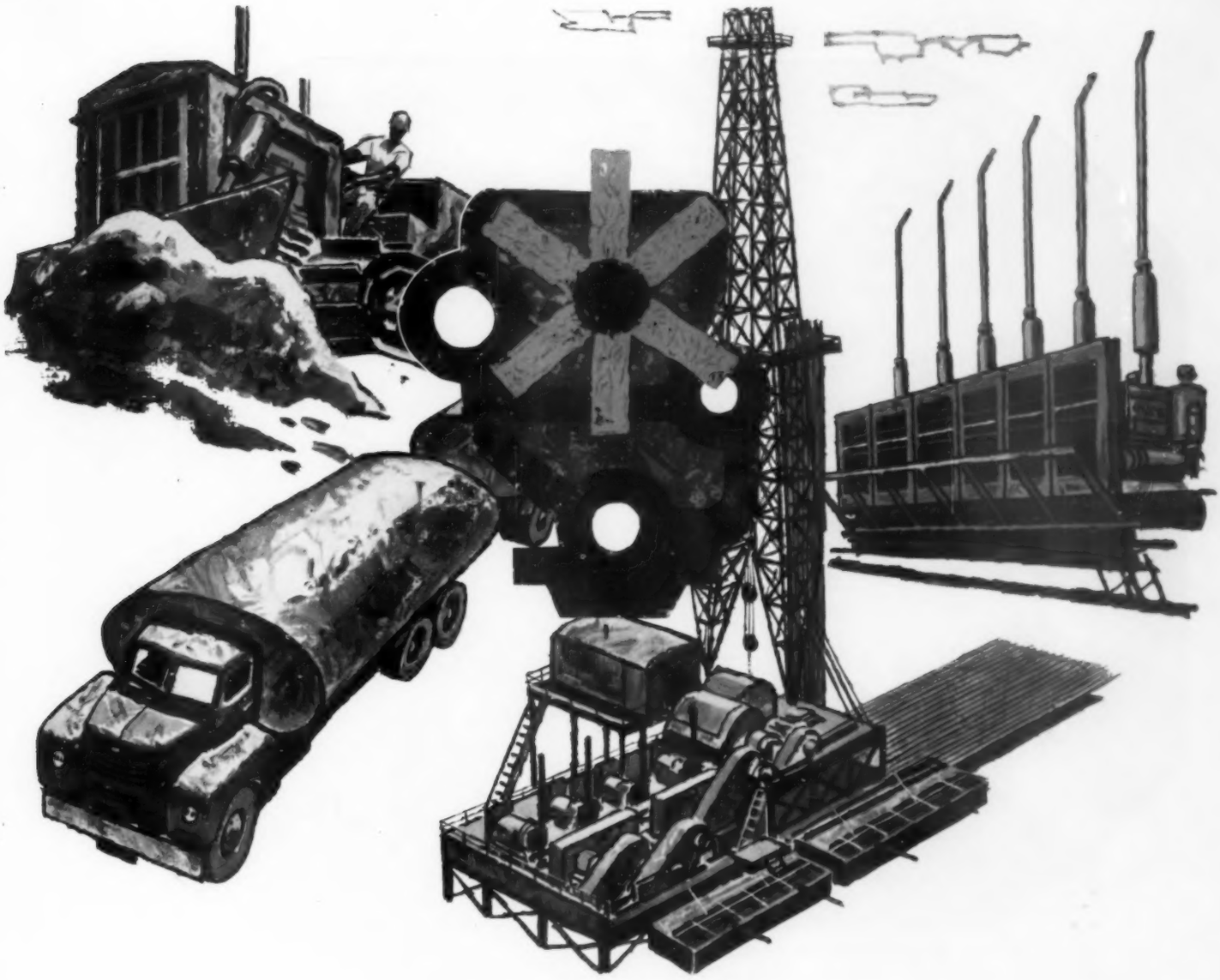

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A SELF-DEFEATING PROPOSAL

The "rugged individualism" of an earlier generation has given way in recent years to the theory that the government has a duty to protect the individual against the harsh winds which buffet him from time to time in a free economy. It makes no difference whether the troubles arise from errors in judgment on the part of the individual or through no fault of his own. There are always some who feel that the government should keep them in economic health—passing on the cost to the general public, of course.

Unfortunately, for the people as a whole or for those seeking shelter, such government aid seldom, if ever, seems to be a genuine solution. The American farmer is a prime example. He is not happy with his economic lot today in spite of government price supports and the accumulation of vast inventories. Another example is the domestic oil producer. Restrictions on imports of foreign petroleum to maintain the domestic producing industry in a state of glowing health 'in the interests of national defense" have not helped to make him happy. Encouraged by the government umbrella, the producer has diligently pushed ahead his flooding and other production stimulation projects and his development and wildcatting program. He and his refiner customer have created burdensom inventories. Texas again has limited production to eight days and happiness still eludes him. He has disobeyed a law not enacted by Congress—the law of supply and demand—and the penalties of the law are being imposed. The law in question is self-enforcing and not capable of being evaded.

Recently a new attempt has been launched in Washington to find a means of escaping the law of supply and demand. In this case the government is being asked to grant more shelter to the operators of tankers operating under the American flag. Domestic tankers already have complete protection against foreign competition in intercoastal operations. To this monopoly they now ask that half of all imports be added.

National defense again is brought out, dusted off and urged as a compelling reason for the mandatory shift in tonnage to American flag vessels. It is urged that public policy requires control in case of war.

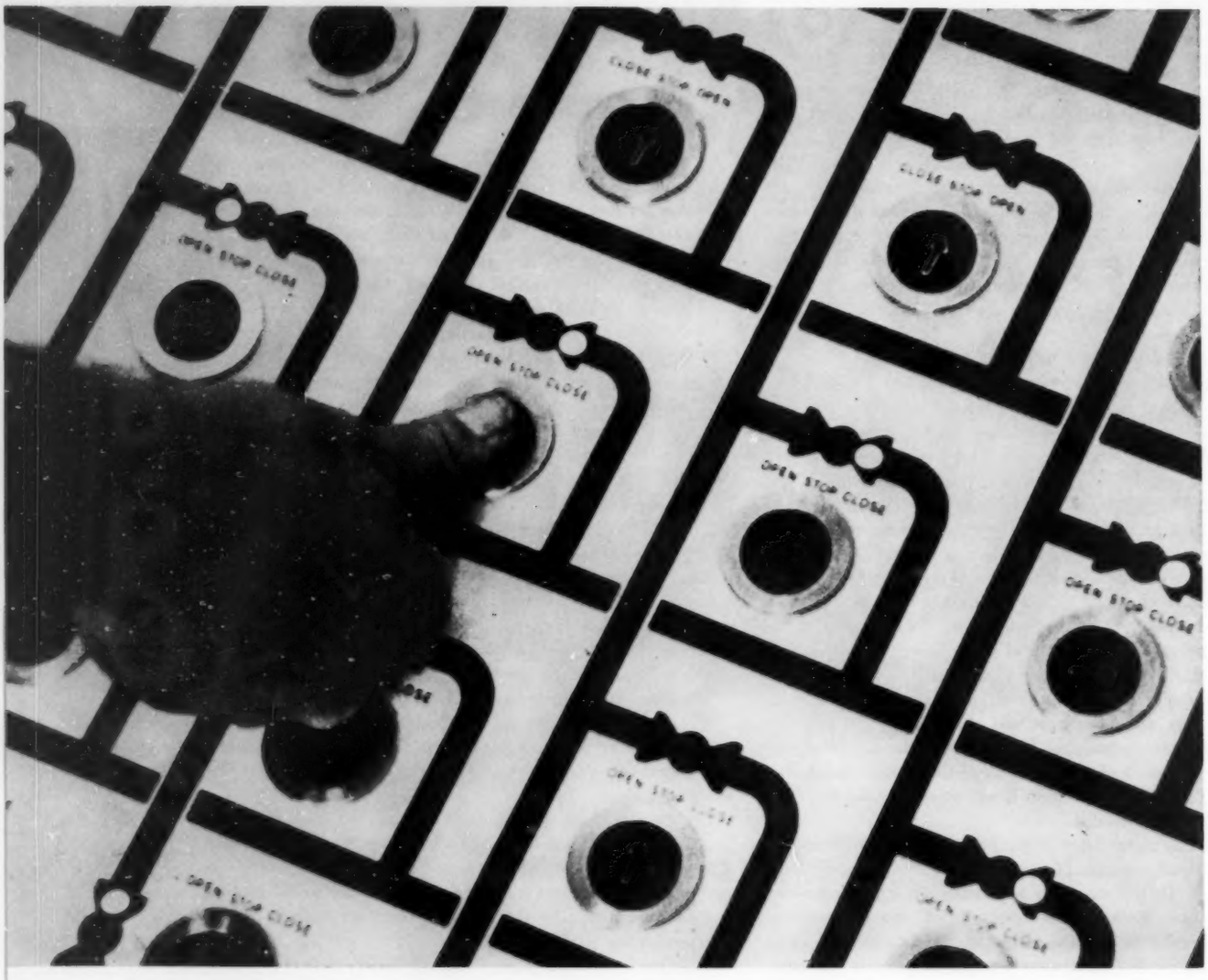
Unfortunately for the Joint Committee for American-flag tankers and the Committee of American Tanker Owners, Inc., the national defense argument is unseaworthy and will not float. The government now has effective control of a very large fleet of modern tankers not now flying the American flag. This fleet is available on instant notice in case of emergency. The fleet was created through economic necessity to meet international competition but the use of flags of necessity have not alienated the tankers owned by subsidiaries of American companies.

Skyrocketing labor costs have created the necessity for registration of vessels under the flags of Panama, Honduras and Liberia. Under USA law an American-flag tanker must be built in USA yards and this more than doubles first cost. A 47,000 dwt tanker built in the USA now costs about $15 million while the same vessel can be launched for $6.7 million from foreign yards. Even more important than capital costs are the labor costs. Daily operating cost of a T-2 tanker operating under Honduran, Panamanian or Liberian flags is about $800 compared with $2,200 for an American-flag tanker.

Various authorities have estimated the effect of the ship-owners' proposal on the costs of importing oil into the USA, and the minimum sum mentioned is in excess of $100 million yearly. These figures are the direct costs and ignore what would happen to intercoastal rates on domestic oil carried from the Gulf Coast to the eastern seaboard. There are not enough domestic tankers available to bring in 50 per cent of the foreign oil required and this means that Gulf-North of Hatteras rates would put on another show similar to that caused by the Suez crisis. At that time spot fixtures were placed at USMC plus 200 per cent. This would be a tremendous temporary windfall for tanker owners at the expense of the consumer. Some of the independent tanker owners who are hoping for such a situation are ones who got into the shipping business at the time of the Suez crisis in the mistaken impression that the tanker shortage would continue indefinitely.

As of January 1 there were only 15 independently owned American-flag tankers in tie-up. One of those has since been scrapped. Surplus independent tonnage was only 260,000 dwt—a small segment of the world surplus and much smaller than the oil company tankers out of service for want of cargoes.

One important factor which the tanker owners overlook is that raising the cost of tanker rates by government intervention will have the effect of driving a larger share of the intercoastal oil traffic into pipelines. Even at existing rates there has been some tendency in this direction. Big-inch pipelines offer cheap transportation and once they are in the ground and pumping oil the business will not return to sea quickly. What might be gained by edict could well be lost to the pipelines. Domestic tanker movement of oil to the East Coast in 1959 totaled 682 million barrels and total foreign imports to the USA were 516 million barrels. Government edict will not repeal the law of supply and demand. It could by artificially raising tanker rates, however, drive many millions of barrels of intercoastal oil traffic underground, defeat the purposes sought and leave the independents in worse shape than they are today.



Automation Art . . .

Pushbutton control creates a pleasing pattern in this valve panel in a huge piping manifold at Esso Standard France's Bordeaux refinery, a new 31,500 b/d plant which went on stream last year at Ambes. This was the second completely new refinery to be built in France since the close of World War II. The first went into operation at Dunkirk in 1952 for Societe Generale des Huiles de Petrole. Both refineries were designed, engineered, and constructed by The Lummus Co. The Bordeaux refinery follows the general pattern of new plants being built currently by affiliates of Standard Oil Co. (New Jersey). Relatively simple processing includes atmospheric and vacuum distillation with hydrofining and Powerforming to produce the required gasolines.

Oil-company earnings and finance point up profit-margin squeeze

by Dillard Spriggs*

Forty leading oil companies earned $3.46 billion in 1959 compared with $3.22 billion the previous year but net profit dropped from 9.65 to 9.45 percent of net worth

THE PETROLEUM INDUSTRY has experienced a serious squeeze on profit margins ever since the end of the Suez crisis. This situation—a reflection of the abundance of worldwide crude-oil supplies — and other financial details of many leading oil companies are pointed up in the accompanying table.

In interpreting these detailed statistics it needs to be remembered that 1958 was a year of sharp decline in the earnings of most oil companies, a year when economic recession combined with large new supplies of crude oil in such areas as Venezuela to force reductions in many leading oil prices. Last year, relevant statistics for which have only recently been published in annual reports, was one of modest recovery. The year 1960 appears to offer the opportunity for rather appreciable gains in volume of production and sales, but little or none in realized prices. Under this circumstance, the profits of most oil companies cannot be expected to show very pronounced increases from 1959. For this reason, the data shown in the accompanying table are likely to be revealing of current and prospective profitability trends in the oil industry.

*Analyst, Baker, Weeks & Co., New York.

Integrated Companies: Perhaps the most striking statistics of all are those referring to the large and partly integrated refining companies which conduct a significant part (in some cases, all) of their marketing business on the East Coast. Profitability ratios — net income expressed either as a percentage of gross income or as a percentage of corporate net worth—generally are on the order of only 5% (see, for example, the results of Atlantic Refining, Cities Service, Sinclair, and Sun).

Certain other partly integrated companies also reveal similarly low results; but, in the main, most are slightly higher. A few (Richfield, Sunray Mid-Continent, and Shamrock) show significantly greater returns, ranging above 15%. The most important factors responsible for these results appear to relate to geographical advantages, i.e., regionally stable marketing conditions, and to favorable product mixes, i.e., higher proportions of profitable business resulting from natural gas and natural-gas-liquids operations. It may also be observed that these companies are considerably smaller than those first mentioned. It may well be that firms of this size can be operated and managed more effectively than the larger ones. This is a subject well beyond the scope of the present article.

Between the above extremes, there are a few other companies (Continental, Ohio, Phillips, Shell) which have returns on net worth of about 10% or better. These companies are either fully integrated or meet a high proportion of their crude-oil needs from relatively low-cost crude-oil reserves found 20 or more years ago—factors which appear to be mainly responsible for their favorable results.

Producing Companies: The profitability of most companies engaged solely in crude-oil production—historically higher than all other companies—continues at advanced rates (see Amerada and Honolulu). However, above-average results are not universal in the producing branch (see Superior and Texas Gulf).

International Companies: The profits of most of the USA international companies show satisfactory returns on net worth, although here again it has to be observed that participation in the international industry does not insure high profitability (see Socony Mobil). In general, the profitability ratios of the USA firms compare favorably with companies which are engaged solely in foreign operations or with the partners in the Royal Dutch-Shell

SALIENT FINANCIAL DATA FOR 40 LEADING OIL COMPANIES (MILLIONS OF DOLLARS)

Company		Gross Income (1)	Depreciation Depletion, etc. (2)	Net Income (3)	Cash Earnings (4)	Capital Expenditures (5)	Cash Dividend on Common Stock (6)	Net Worth (7)	No. Of Common Shares (8)	Net Income Per Share (9)	Net Income As % of Gross (3)÷(1)	Net Income As % of Net Worth (3)÷(7)
Amerada	1959	102.4	14.8	24.0	58.7	42.6	12.6	167.9	6,313,310	3.81	23.4	14.3
	1958	102.8	13.2	22.5	58.8	46.3	12.6	156.5	6,313,310	3.56	21.9	14.4
Ashland	1959	73.6	14.8	14 3	29.2	16.9	5.8	126.3	6,102,462	2.09	19.4	11.3
	1958	63.8	15.0	10.3	25.3	17.0	5.7	119.8	5,734,582	1.51	16.1	12.5
Atlantic Refining	1959	544.7	47.4	30.2	89.0	79.0	18.1	516.7	9,050,783	3.19	5.5	5.8
	1958	542.1	46.4	36.1	93.6	84.4	17.9	504.6	9,010,088	3.86	6.7	7.2
Cities Service	1959	994.9	85.2	42.4	127.6	132.8	25.8	652.3	10,729,180	3.96	4.3	6.5
	1958	1,015.3	82.6	38.3	120.9	97.5	37.2	635.6	10,729,180	3.57	3.8	6.0
Colorado Oil & Gas	1959	45.8	4.5	2.5	8.3	6.2	—	35.6	3,147,062	.79	5.5	7.0
	1958	33.3	3.9	.6	5.4	10.8	—	35.1	3,066,646	—	1.8	1.7
Continental	1959	786.8	42.0	60.3	139.6	99.0	35.3	482.4	21,122,922	2.85	7.7	12.5
	1958	751.8	37.1	48.4	123.2	79.9	31.4	400.4	20,137,045	2.40	6.4	12.1
Delhi Taylor	1959	88.1	3.3	2.7	8.9	4.4	—	20.7	5,316,842	.51	3.1	13.0
	1958	69.4	3.9	−1.6	5.6	3.8	—	18.1	5,316,842	−.30	—	—
Getty	1959	48.6	8.9	10.7	19.7	——	—	144.7	16,004,228	0.67	22.0	7.4
	1958	28.0	5.2	12.9	19.4	——	—	142.2	16,004,228	0.79	46.0	9.1
Gulf	1959	3,202.8	260.8	290.5	622.4	335.8	96.9	2,631.5	100,120,192	2.90	9.1	11.0
	1958	3,222.2	261.2	329.5	652.5	401.2	77.7	2,444.1	32,390,039	3.29	10.2	13.5
Honolulu	1959	44.9	11.4	12.9	24.7	16.7	7.5	91.8	3,750,972	3.44	28.7	14.1
	1958	40.8	10.4	11.8	22.2	10.9	7.5	86.6	3,750,972	3.16	28.9	13.6
Kear-McGee	1959	134.2	10.2	5.9	21.6	13.2	1.9	78.8	2,395,611	2.13	4.4	7.5
	1958	119.9	8.8	5.4	19.3	17.8	1.9	75.1	2,378,575	1.94	4.5	7.2
Louisiana Land	1959	38.7	2.2	19.4	25.1	——	14.4	39.7	8,972,918	2.16	50.1	48.9
	1958	32.9	1.5	17.4	20.0	——	13.4	33.9	8,965,993	1.94	52.8	51.3
Ohio Oil	1959	349.5	27.3	38.6	97.8	84.3	22.0	408.3	13,973,575	2.76	11.1	9.5
	1958	274.4	24.9	32.2	84.5	66.5	21.0	367.2	13,126,753	2.45	11.7	8.8
Phillips	1959	1,179.2	122.5	104.6	227.1	120.8	58.4	1,052.6	34,357,694	3.05	8.9	9.9
	1958	1,072.9	127.7	84.2	211.9	132.8	58.4	1,006.2	34,353,174	2.45	7.8	8.4
Plymouth	1959	90.0	4.8	2.2	10.3	6.4	3.1	57.2	2,652,034	0.84	2.4	3.8
	1958	86.2	5.2	4.6	12.1	9.7	3.0	58.1	2,652,034	1.79	5.3	7.9
Pure Oil	1959	504.9	31.4	28.9	65.9	44.5	13.9	398.8	8,700,130	3.32	5.7	7.2
	1958	478.3	29.9	28.8	62.8	46.9	13.8	379.4	8,602,469	3.35	6.0	7.6
Quaker State	1959	55.2	1.7	2.4	4.1	1.7	1.3	32.1	927,305	2.89	4.3	7.5
	1958	49.9	1.9	1.9	3.8	1.0	1.3	32.1	927,305	2.29	3.8	5.9
Richfield	1959	272.4	27.7	28.1	64.1	55.5	14.1	246.1	4,039,003	6.95	10.3	11.4
	1958	260.1	26.5	20.1	57.3	47.1	14.0	230.8	4,020,128	5.02	7.7	8.7
Shell	1959	1,819.9	195.4	147.4	342.8	280.1	62.1	1,325.1	60,573,000	2.43	8.1	11.1
	1958	1,674.1	194.6	128.6	323.1	223.1	60.6	1,239.8	30,287,000	2.12	7.7	10.4
Shamrock	1959	57.4	6.0	9.2	15.2	13.9	5.6	52.2	3,481,061	2.64	16.0	17.6
	1958	56.7	5.0	9.1	14.2	12.8	5.5	47.9	3,459,030	2.62	16.0	19.0
Signal Oil & Gas	1959	171.7	11.1	16.3	36.4	27.5	7.1	190.2	9,507,811	1.71	9.5	8.6
	1958	131.5	9.3	17.5	35.0	24.6	3.6	173.7	8,825,597	1.84	13.3	10.1
Sinclair	1959	1,246.4	88.3	45.5	163.0	124.4	46.1	1,494.1	15,565,808	2.96	3.7	3.0
	1958	1,201.7	89.5	49.5	165.1	131.4	45.9	1,499.9	15,565,383	3.23	4.1	3.3
Skelly	1959	259.6	37.5	28.0	65.5	60.4	10.3	360.1	5,746,117	4.87	10.8	7.8
	1958	255.7	35.8	27.7	63.5	62.9	10.3	342.5	5,746,117	4.81	10.8	8.1
Socony-Mobil	1959	3,150.3	221.6	163.9	426.5	258.2	97.0	2,519.8	48,582,296	3.38	5.2	6.6
	1958	2,932.9	207.8	156.8	389.6	313.6	96.7	2,445.1	48,432,767	3.24	5.3	6.5
Std. of Calif.	1959	1,909.1	141.1	253.6	394.7	399.9	126.4	2,120.0	63,224,386	4.01	13.3	11.9
	1958	1,902.4	145.9	257.8	403.7	343.3	126.4	1,990.2	63,224,386	4.08	13.6	12.9
Std. of Ind.	1959	1,980.8	171.6	139.6	336.1	301.1	54.5	2,161.9	35,769,976	3.90	7.0	6.5
	1958	1,882.4	172.3	117.8	320.8	293.8	53.2	2,076.9	35,769,976	3.29	6.3	5.7
Std. of N. J.	1959	8,102.8	527.7	629.8	1,157.5	729.1	481.0	6,687.7	216,533,000	2.93	7.8	9.4
	1958	7,712.3	487.5	562.5	1,050.0	859.0	465.0	6,457.2	214,890,000	2.72	7.3	8.7
Std. of Ohio	1959	396.6	25.6	25.1	59.0	40.4	12.1	280.5	4,848,571	5.02	6.3	8.9
	1958	394.8	24.0	24.0	53.8	40.3	12.1	268.4	4,827,093	4.82	6.1	8.9
Sun Oil	1959	746.3	52.8	42.8	134.3	94.0	11.7	581.7	12,419,078	3.48	5.7	7.4
	1958	724.0	56.4	32.1	118.6	70.7	11.4	550.6	11,832,110	2.73	4.4	5.8
Sunray Mid-Continent	1959	454.7	31.7	43.8	92.4	67.7	23.3	461.3	17,939,276	2.25	9.6	9.5
	1958	375.2	28.7	40.7	84.2	52.5	22.9	436.6	17,384,179	2.14	10.8	9.3

Company		Gross Income (1)	Depreciation Depletion, etc. (2)	Net Income (3)	Cash Earnings (4)	Capital Expenditures (5)	Cash Dividend on Common Stock (6)	Net Worth (7)	No. Of Common Shares (8)	Net Income Per Share (9)	Net Income As % of Gross (3)÷(1)	Net Income As % of Net Worth (3)÷(7)
Superior of Calif.	1959	131.9	12.0	19.4	71.1	74.1	1.3	163.9	422,264	45.84	14.7	11.8
	1958	111.4	11.5	16.6	63.4	72.5	—	145.9	422,264	39.20	14.9	11.4
Texaco	1959	2,830.8	247.8	354.3	635.1	419.7	153.2	2,517.8	61,215,978	5.85	12.5	14.1
	1958	2,580.2	235.1	311.2	580.5	432.3	134.8	2,315.6	60,015,665	5.24	12.1	13.4
Texas Gulf Prod.	1959	17,7	3,8	4.2	10.4	4.0	2.4	43.3	4,035,005	1.04	23.7	9.7
	1958	18.5	3.7	3.9	10.9	3.1	2.4	41.4	4,029,597	.98	21.1	9.4
Tidewater	1959	559.4	58.5	33.9	92.4	100.1	—	478.7	13,939,448	2.23	6.1	7.1
	1958	552.4	60.4	2.6	63.0	94.1	—	448.3	13,294,712	.03	.5	.6
LATIN AMERICAN												
Creole	1959	966.4	84.7	200.3	318.0	61.1	201.8	844.7	77,621,210	2.58	20.1	23.7
	1958	1,024.2	77.2	235.7	339.0	140.5	279.4	846.2	77,621,210	3.04	23.0	27.8
CANADIAN												
British-American	1959	330.9	34.4	25.6	60.0	70.9	12.1	417.2	20,458,983	1.25	7.8	6.1
	1958	320.7	31.8	20.5	52.3	81.5	10.6	403.5	20,458,983	1.00	6.4	5.1
Imperial Oil	1959	866.8	43.7	54.5	98.2	62.2	37.8	894.1	31,461,800	1.73	6.3	6.1
	1958	838.8	44.9	50.6	95.5	65.6	37.7	861.6	31,451,252	1.61	6.0	5.9
Texaco Canada	1959	185.1	8.1	10.4	19.7	15.9	5.2	107.8	3,238,453	3.16	5.6	9.6
	1958	176.2	7.5	9.4	18.1	11.6	5.2	102.9	3,238,453	2.86	5.3	9.1
EUROPEAN												
British Pet. Ltd.	1959	158.8	87.4	71.4	—	—	63.8	1,250.1	210,244,820	.34	44.9	5.7
	1958	157.5	105.8	51.8	—	—	49.6	1,027.6	202,401,340	.26	32.9	5.0
Royal Dutch Pet.	1959	4,374.0	301.8	295.2	597.0	253.2	99.9	3,410.0	72,391,577	4.05	6.7	8.7
	1958	3,997.2	278.4	267.0	545.4	232.2	90.3	3,050.9	68,420,565	4.11	6.6	8.8
Shell T & T	1959	2,916.0	201.2	197.0	398.2	169.0	63.3	2,288.7	95,905,765	2.04	6.7	8.7
	1958	2,663.0	185.6	178.0	363.6	155.0	46.8	2,044.0	89,949,247	1.98	6.6	8.8

Gross income includes operating and nonoperating revenues.
Cash earnings include net income, depreciation and depletion, retirements, lease cancellations, dry holes, and intangible development costs.
Capital expenditures exclude exploratory expenses.

group. It is to be observed, however, that the results of Creole Petroleum Corp., operating in Venezuela, are well above average.

Financing Problems: The rate at which companies are earning on their net worths is, of course, only one index of financial strength. Another big measure may be found in the coverage which cash earnings (net income, depreciation and depletion, dry holes, etc.) provide for capital expenditures and cash dividends (plus a variety of other outlays, usually small). The details of this coverage, company by company, do not need to be reviewed here, but a general observation can be made. Cash earnings do not have to provide a wide coverage over needs so long as a firm's working-capital position is sound. But in periods such as the oil industry now faces it is probably prudent to achieve a relatively close balance between cash income and outgo. Otherwise, resort must be made to the capital markets, either for equity financing or long-term debt. In each case, the cost to the company for this new capital would be relatively high because of conditions in the oil industry and current tightness of the capital markets.

For these reasons (and also because of oversupply conditions) current and prospective capital spending programs of many oil companies are being curtailed or at least being held in line with recent spending rates. Companies with relatively high dividend requirements, in particular, must exercise careful judgment.

At the same time, however, adversity spells opportunity. A few companies which have a good financial position, combined with low dividend claims on cash earnings, are seizing the opportunity to step up spending and expansion programs. If they are successful, their competitive positions and market shares will be in for improvement—the goal of every alert management.

END

Lonely camp of an Aramco seismograph party in the remote Rub' al-Khali (Empty Quarter") of Saudi Arabia is dwarfed by the surrounding masses of sand (Aramco photo).

The 24-inch pipe is welded and ready for lowering into trench being cut by the ditching machine.

Crude starts flowing through Rotterdam-Rhine pipeline

Operations scheduled to begin in July, with initial throughputs up to 150,000 b/d and ultimate rates planned at 400,000 b/d. Line will feed refineries at Godorf, Wesseling, and Gelsenkirchen from terminal at Pernis

by H. J. Slingenberg and G. R. E. Einsel

TWO YEARS AGO a number of oil companies decided to build a pipeline to the Rhine/Ruhr area. The ever growing demand for petroleum products in the German industrial areas as well as the desire for reliable transport facilities played important roles in this decision. A pipeline system eliminates the inherent difficulties of transport by barges or other means of transport, like ice, fog, high and low water levels, congestion of rivers, canals, and roads. Also, on the basis of calculations, it can be shown that this pipeline takes care of our transport requirements in a more economical way.

After basic agreement between participants was reached, a new company, the N. V. Rotterdam-Rijn Pijpleiding Maatschappij was established in the spring of the year 1958. In this company the following companies are participating: Bataafse Petroleum Maatschappij N. V., The Hague (40%), Gelsenberg & Mobil Oil Handels-und Transport-GmbH (40%), and California Texas Oil Corp. (Caltex) New York (20%).

Equity capital amounts to 35 millions of guilders. Further requirements are covered by a debenture loan in the Netherlands of £60 millions, and a loan of DM 33 millions in Germany. Total cost is estimated at £125 millions.

The project includes a 24-inch, 155-km pipeline from Pernis in the Rotterdam harbour area to Venlo. At this point the line splits in a 24-inch, 103-km line to Godorf and Wesseling near Cologne, and a 24-inch, 45-km line to Wesel. At the latter place the line is connected to an existing 16-inch line which runs from the harbor area in Wesel to the Gelsenberg Benzin A. G. refinery in Gelsenkirchen. In Godorf a new refinery is under construction for Deutsche Shell A. G. and in Wesseling is a refinery where Caltex has certain interests. The project includes two pumping stations, at Pernis and Venlo.

The line will transport crude oil only, and will go into operation on July 1, 1960. During the first phase of operation an annual throughput of up to 8.5 million tons (150,000 b/d) is anticipated. The quantities destined for Godorf and Wesseling are pumped by the Pernis station without any additional pumping stations. For the Gelsenberg oil, a tank farm with pumping station is being built in Venlo, which will not only pump the oil to Wesel but also

from there through the existing 16-inch line to the Gelsenberg refinery in Gelsenkirchen. Owing to the smaller diameter of the latter section, a tank farm in Venlo is necessary for buffer storage.

Additional pumps at Venlo which will also serve the branch to Godorf and Wesseling will increase the capacity of the line to 10 million tons/year.

A final capacity of almost 20 million tons/yr (400,000 b/d) may be achieved by erecting two more pumping stations between Pernis and Venlo.

Some of the requirements for the construction were as follows: 36,500 tons of 24-inch pipe, 600 tons of fittings, 950 tons of tank steel, 580,000 sq. meters of insulating material of 5-mm thickness, 4,500 tons bitumen and coal tar, and 1,250,000 cu meters of earth to be moved.

The entire line contains a volume of about 88,000 cubic meters which means that approximately three or four ocean going tankers will be required to fill the line for operation.

The initial capacity of 8.5 million tons per year entails a rate of flow of approximately 1 meter/second. The final capacity of almost 20 million tons/yr will increase the speed to approximately 2.6 meter/second. This implies that in the beginning the oil will run at a rate of 3½ km/hour and will need approximately 72 hours—or 3 days—to cover the distance of 258 km to Wesseling and about the same time to Gelsenberg refinery.

To obtain these rates of speed a pressure of almost 55 kg/cm² is required. The centrifugal pumps at Pernis, which have a capacity of 1,100 cu meters/hr at the required pressure, are driven by electric motors with a capacity of 1,750 hp each. This requires two pumps to be connected in series while a third pump stands by for reserve. The corresponding data for Venlo are 850 cu meters/hr and 1,250 hp in view of the smaller line diameter of the Gelsenberg pipeline.

These high pressures necessitate of course the highest quality pipe which can take the full strain it will be exposed to. The pipe will be continuously inspected during operation. For many reasons, leaks are most undesirable and must be avoided as much as possible, at least be detected at once. This is especially important in drinking water areas. The inspection did not start at the beginning of operations but took place even earlier, in the pipemills of Phoenix Rheinrohr and Mannesmann in the Ruhr area. From an economic point of view, pipe of 24-inch diameter cannot be rolled seamless in large quantities at the present stage of technique. The necessary longitudinal seam is welded electrically on the inside and outside of every length of pipe. Prior to rolling, the steel plates are subject to inspection for defective spots in the material. After welding, the whole longitudinal seam of every length of pipe (usually 12 meter) is tested ultrasonically. Spots which give rise to doubt are checked by X-rays.

Subsequently, a hydraulic water pressure of some 100 kg/cm² is applied, which causes the pipe to expand slightly. Strange as it may sound, this method relieves existing welding stresses extensively, eliminating the need for annealling.

Inspection was continued consistently when the line was laid in the soil. None of the circumferential welds were accepted without ultrasonic testing and approval. Moreover, a number of circumferential welds were also X-rayed, especially in the drinking water areas. The greatest attention was paid to the careful handling of a pipeline section during construction. The most experienced men of any construction team were employed for this phase of the job.

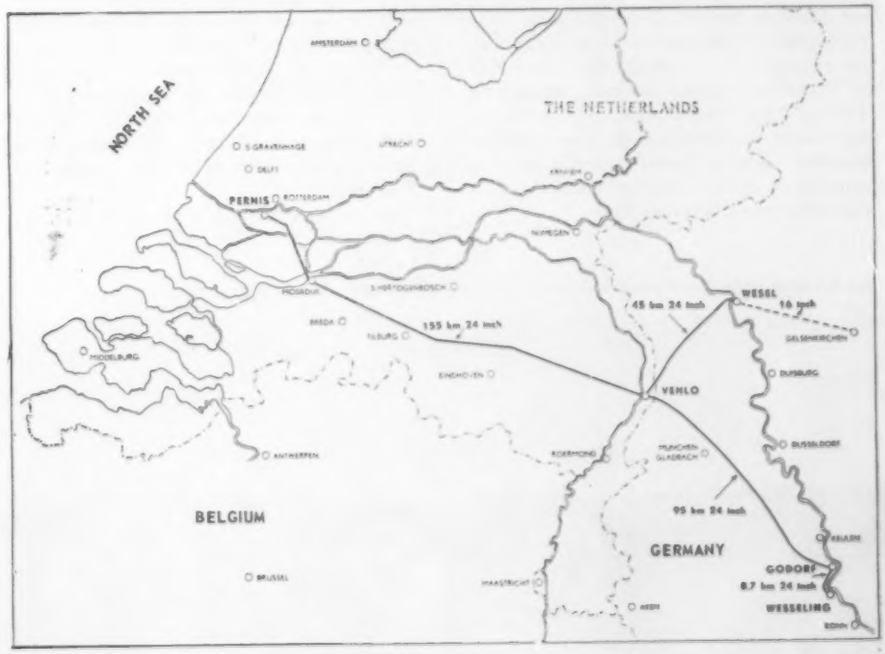
After the completion of a sufficiently large section, a pressure test was applied which constituted a real breaking test. Water pressure which put the material to a strain of 90% of the permissible tensile strength was maintained for 24 hours; river crossing lines and lines through drinking water areas were subjected to this test for 48 hours. With the numerous pressure tests carried out so far only one pipe actually burst. This was caused by a material defect far away from any welding seam. During actual operation the highest pump pressure will reach less than 60% of the tensile strength, which means that a considerable and fully sufficient safety factor is available.

This carefully constructed pipeline needed, of course, just as careful protection against chemical or electrical influences in the soil. This is effected firstly through a reliable tar or bitumen saturated insulation of which the sealing-off quality was checked by a high tension current of 20,000 volts and secondly, by the so-called cathodic protection method, which must be adapted to

G. R. E. Einsel was born in Germany in 1900 and educated at the Berlin Technical University. From 1926 to 1948 he was with I. G. Farbenindustrie at Ludwigshafen and Leuna, and from 1948 to 1958 he was at the Gelsenkirchen works of Gelsenberg Benzin A. G. as chief engineer. On June 1, 1958, Mr. Einsel was named managing director of N. V. Rotterdam-Rijn Pijpleiding Maatschappij.

H. J. Slingenberg, born in the Netherlands in 1911, joined the Royal/Dutch Shell Group in 1953 after 20 years with a large Dutch banking firm. After working with Shell Nederland N.V. and the Shell Petroleum Co. Ltd., Mr. Slingenberg became finance manager of Shell Italiana in 1954. He was appointed managing director of N. V. Rotterdam-Rijn Pijpleiding Maatschappij April 3, 1958.

Route of the new Rotterdam-Rhine pipeline comprises some 300 km of 24-inch line.



Trench is completed and pipelaying machines start lifting completed pipe into proper position.

the existing electrical potentials present.

During operation the pipeline will be protected automatically against any excess pressures—which can occur only with wrong manipulation of the equipment—through a pressure warning unit installed on the pressure end of the pumps which switches off the motors in cases of emergency. In the same way the motors are automatically switched off immediately when the pressure drops suddenly; e.g., as a consequence of a pipe break. The line is of course sub-divided in sections, which can be closed individually, especially in river crossings, permitting a leak to be quickly isolated.

Many operations are effected automatically, for example the receiving points in the three refineries where pressures, temperatures, specific gravities and quantities are measured and automatically transmitted to Pernis at regular intervals through a Telex system. Also, pumps and motors report automatically to a control room at the so-called "graphic panel" when a bearing runs hot or strong vibrations occur or when the stuffing box becomes leaky.

These automatic devices help to minimize the number of operating personnel at the pumping stations. Of course, they must be highly qualified men.

Efficient control of construction and operation must necessarily be concentrated on those points where natural difficulties occur; for instance, the high ground water levels in the Netherlands, where the soil lies as low as 8 meters below sea level, and other dangers which exist in mining and drinking water areas. Close contact is kept with the German water authorities for the provision of safety measures to be applied in the drinking water areas. Moreover, we are receiving the advice of a number of well known Dutch and German professors. It is our wish to apply a method of construction which provides a full safeguard against damages to soil and drinking water.

The N. V. Rotterdam-Rijn Pijpleiding Maatschappij engaged Bechtel International Co. for the necessary engineering advice and supervision on the construction. This firm is a subsidiary of Bechtel Corp., San Francisco.

In addition to the office of the N. V. Rotterdam-Rijn Pijpleiding Maatschappij in The Hague, there was a construction office at van Alkemadelaan 700, The Hague where some 20 experienced American employees of Bechtel International formed the nucleus of an organization completed with Dutch engineers, draughtsmen, and accountants comprising some 90 persons.

In view of the size of the project, a number of important Dutch contractors were involved, mostly in combination with German, American or English firms of excellent standing.

It is interesting to consider also the tasks which had to be performed outside the actual construction.

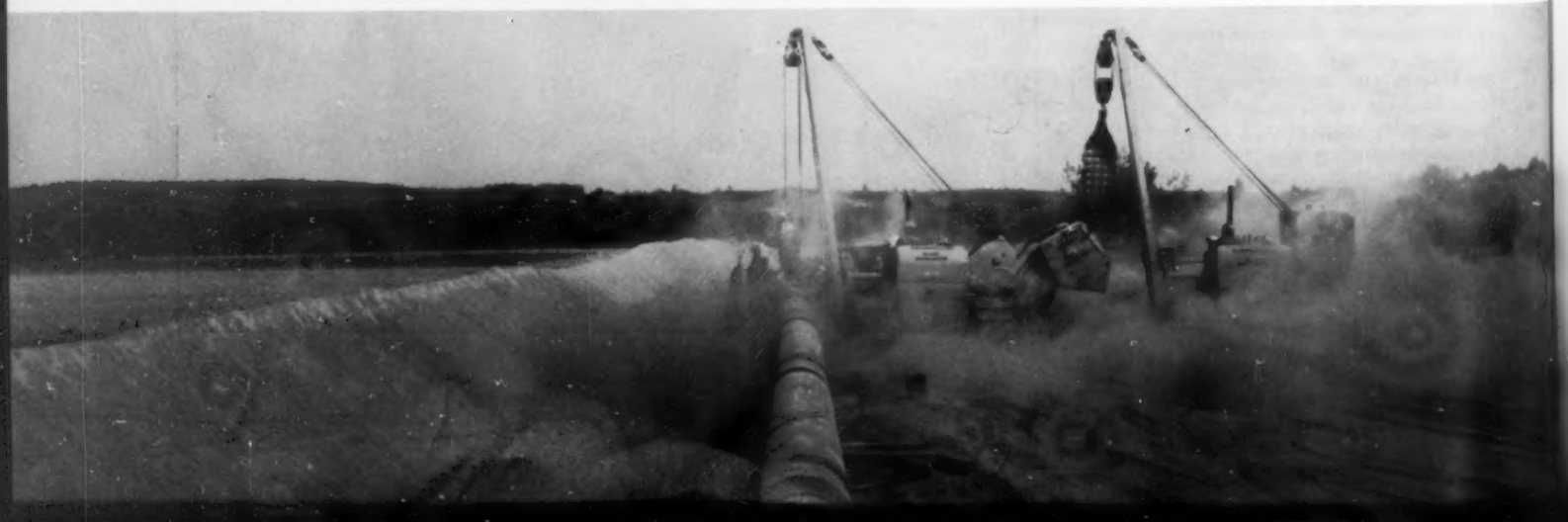
For instance, in the Netherlands alone, the property of some 1,300 landowners was touched. Agreements with these 1,300 owners was reached on the granting of real rights. The Netherlands State granted the pipeline firm a concession and a declaration of public interest. We were lucky in obtaining the cooperation of landowners and tenants, and the concession was never used for the establishment of our right-of-way.

A great number of permits had to be acquired, e.g. those for crossing rivers, canals, railways, roads, dykes, etc. The necessary negotiations with the water authorities, Provincial authorities, National Plan Board, Cultural Technical Board, Deputy States, Municipal Boards, polder authorities, agricultural organizations, Dutch Railways, etc., were interesting, and sometimes prolonged. However, the manner in which we received cooperation and understanding for our interesting project, stimulated us in our job.

Economic relations. Recently, much has been written in Dutch and German newspapers on pipelines and their economic significance, their advantages and also on new plans and on lines from the Mediterranean. There has also been some talk about a possible combination of this line with other lines. This pipeline has been constructed in such a manner that it will be possible to connect it to a European network and at least be integrated into a pipeline from Marseilles to Rotterdam, as was contemplated in earlier propositions. There is, as yet, no prospect that this possibility will be realized within the near future.

END

Pipe has been lowered into position in trench and pipelaying machines are backing off.



Hassi Messaoud—Saharan oil giant

by
C. de Lapparent
Head, Geological Department
Cie. Francaise des Petroles (Algerie)
and
P. Albert
Head, Reservoir Bureau
Cie. Francaise des Petroles (Algerie)

Reserves in the mammoth French Saharan oil field of Hassi Messaoud are authoritatively estimated at 19 million barrels by one of the principal partners. Recoverability is not yet known, but this is certainly one of the world's largest oil fields and a substantial aid to the oil supply system of the French Union.

THE HASSI-MESSAOUD FIELD, located in the French Sahara within the territory of the Common Organization of the Sahara Regions (O.C.R.S.), 100 kilometers to the east of the Oasis of Ouargla and 650 kilometers to the southeast of Algiers, was discovered in June, 1956 by the Md. 1 well (SN Repal). The structural configuration, originally mapped by seismic refraction, gradually became better known through subsurface information obtained from wells. Not evident at the surface due to a recent overlap (Mio-Pliocene), the structure, on the horizons of the Paleozoic, has the shape of an ellipse with NNE-SSW orientation (Fig. 1). The dips are very low (less than ½°); its productive area to the boundary defined by the oil-water contact is, very roughly, 1,500 square kilometers.

The entire reservoir, which is located at an average depth of 10,000 feet (3,300 m.), is siliceous cemented quartzitic sandstone of Lower Paleozoic (Cambrian) age. The Cambrian sandstones are channeled and eroded in their upper part and covered by beds of argillaceous sandstone of the Triassic (base of the Mesozoic), which itself is covered by a thick saliferous series. The latter forms the caprock of the Hassi-Messaoud field (Fig. 2).

The Paleozoic fold has been leveled off

TABLE 1—Hassi-Messaoud Crude Oil[1]
(Type: Intermediate wax-bearing)

Specific gravity, at 15C (59F)	0.806
API gravity	44.0
Sulfur, wt-%	0.16
H_2S, wt-%	0
Pour point, F.	below −50
Wax, wt-%	2
Vis. at 20 C (68 F), centistokes	2.7
Asphaltenes (by heptane) wt-%	0
Conradson carbon, wt-%	0.8
Salt (lb. NaCl per 1,000 bbl)	below 6
R.V.P. psi	8
Acidity, mg KOH per g.	0.018
ASTM Distillation °F:	
IBP	92
5%	163
10%	202
20%	266
30%	318
40%	380
50%	450
60%	527
70%	612
at 680 F, vol-%	80
Lt. Hydrocarbons, vol-%:	
C_3	0.2
C_4's	1.3
C_5's	3.1
C_6	4.0

[1] Source: CFP(A)

TABLE 2—Hassi-Messaoud Crude Oil Product Yields and Properties (Laboratory distillation)[1]

	Deprop. gasol. (to 302F)	Naphtha (302–392F)	Kerosine (302–500F)	Gas Oil (302–707F)	Residue (above 707F)
Yields, wt-%	28.8	11.5	24.5	34.8	24.4
vol-%	33.0	12.2	24.8	32.8	21.2
Sp. grav. at 15C (59F)	0.704	0.785	0.800	0.842	0.921
API gravity	69.5	48.8	45.3	36.5	22.1
Sulfur, wt-%	0.002	0.002	0.008	0.20	0.35
Mercaptans	sweet	sweet	sweet	—	—
Aniline point, F	—	132	—	—	—
Diesel Index	—	63.2	—	—	—
Cetane number	—	—	—	55.5	—
Aromatics, vol-%	4.8	16.0	17.3	—	—
Smoke point, mm.	—	—	27	—	—
RVP, psi	9.3	—	—	—	—
Octane (motor) clear	57.3	39.5	—	—	—
+ 0.75 cc TEL	67.9	—	—	—	—
+ 1.9 cc TEL	76.9	—	—	—	—
+ 3.0 cc TEL	80.7	—	—	—	—
Conradson Carbon, wt-%	—	—	—	0.04*	3.8
Asphaltenes, wt-%	—	—	—	—	0.4
Freezing pt, F	—	—	45	—	—
Pourpoint, F	—	—	—	4	62
Visc at 20 C (68F), Cst	—	—	—	5.2	—
" at 50 C (122F) "	—	—	—	2.6	120
" at 99 C (210F) "	—	—	—	—	16.3
UOP Factor	—	11.9	11.9	11.8	—
ASTM dist., °F, 10%	127	331	356	473	
50%	208	343	394	545	
90%	275	363	455	662	
EP	297	390	475	698	
Vanadium, p.p.m.	—	—	—	—	2

Note: Yields of gas: 0.5 wt-%, 0.8 vol-%.

* on 10%

[1] Source: CFP(A)

by erosion which is particularly active on the higher part of the structure. In addition to this "structural erosion", there is superimposed erosion resulting from a former hydrographic network established on the erosion surface of the Paleozoic (Fig. 2). The erosion phenomenon results, on the one hand, in certain difficulties in drawing the isopachs of the reservoir and, on the other hand, in variations in the average physical characteristics (porosity-permeability) and hence in a certain heterogeneity which gives rise to different zones of productivity. This idea will be further developed below.

Since the average permeabilities and porosities are closely linked with the petrographic composition of the sediment, we consider it helpful to review briefly the lithological sequence of the Messaoud Cambrian.

Within the area of the field, the Cambrian is represented by a sandstone series whose thickness varies according to the erosion at the top and to the variations in thickness of the base series: 400 meters (990 ft.) at well Om 81 and 561 meters (1,851 ft.) at well OmG 57.

As a whole, the sandstones are of variable particle size (medium to very coarse) with crossbedding. The cement is quite variable, ranging from a siliceous cement, which predominates at the top, to an essentially argillaceous cement at the base.

On the basis of electrical and petrographic criteria, four main zones have been distinguished from top to bottom (see Fig. 3):

Q Zone: This zone is totally eroded over the central portion of the field and its maximum thickness on the flanks is 80 meters (264 ft.). It consists of fine- to medium-grained sandstones and quartzite sandstones (average particle size 290 μ, subround) where "Tigillites" are abundant. The cement is almost entirely siliceous resulting in very low porosities (2 to 3%) and, in the absence of any matrix, the permeability is generally less than 1 md. Networks of fine fractures occuring in some places occasionally improve the reservoir characteristics of this zone.

R_1 Zone: This zone constitutes the main portion of the reservoir. Its thickness (where it is not eroded) is 110 meters (363 ft.). Consisting of medium-grained sandstone (average particle size 350 μ, subround), it has substantial variations in facies, the distribution of which, over the field, does not appear to be governed by any simple law. These variations relate to the degree of silicification of the rock. In certain areas a secondary silicification is observed. This silica also fills the fractures where any are present and destroys the reservoir characteristics of this zone.

On the average the cement is mostly siliceous with some clay added (mainly Kaolinite plus illite).

The porosity ranges between 8 and 10%; the permeabilities, which vary between wide limits (1 to 1500 md.), are a function of the cementation factor.

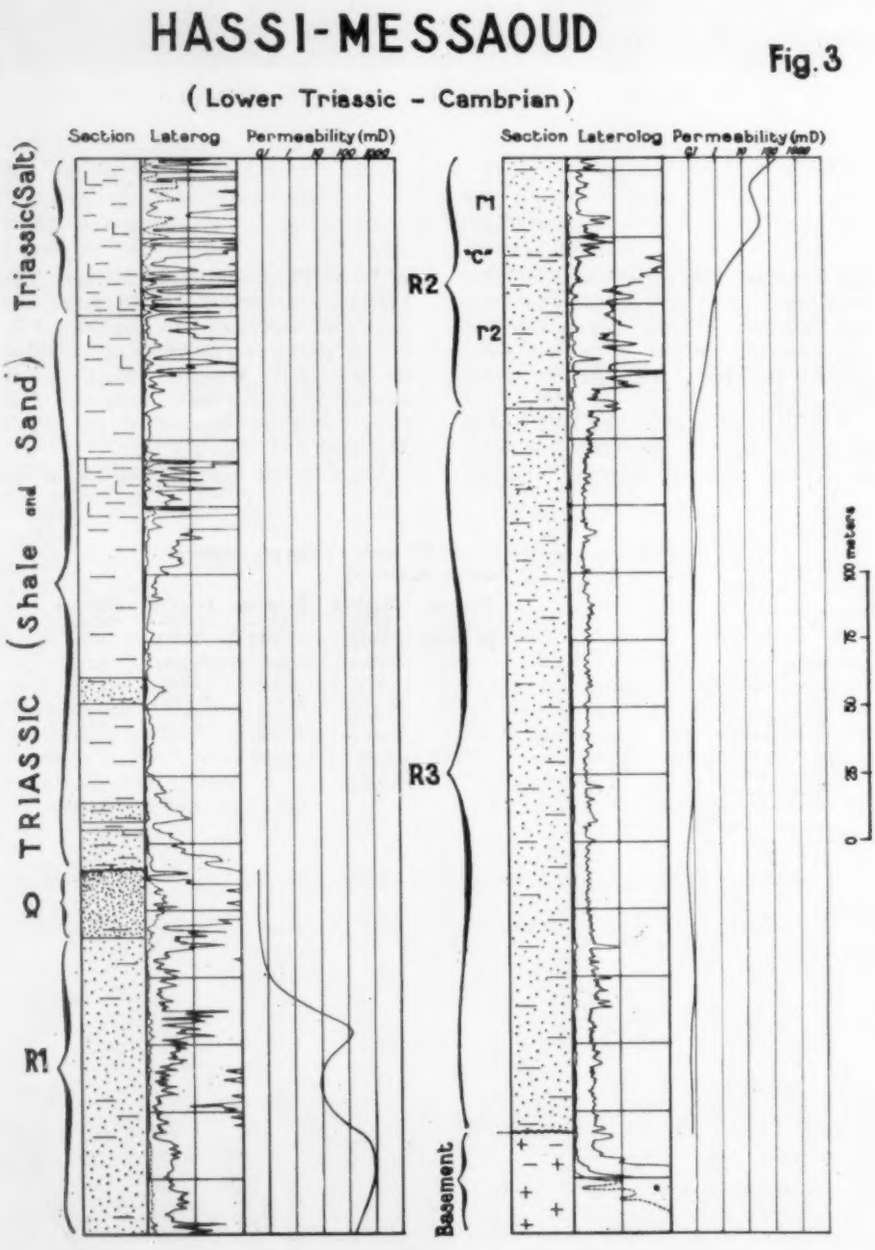
R_2 Zone: This zone is of fairly constant thickness (80 meters or 264 ft.) and is divided into two subzones, namely r_1 and r_2. Its upper portion (r_1) still has sufficient physical characteristics to constitute a satisfactory reservoir (35 m. in thickness). Consisting as a whole of medium- to coarse-grained sandstone (average particle size 460 μ, subround to subangular) in which the percentage of argillaceous cement (illite and kaolinite) exceeds that of siliceous cement, it constitutes a transition between the R_1 zone and the underlying R_3 zone.

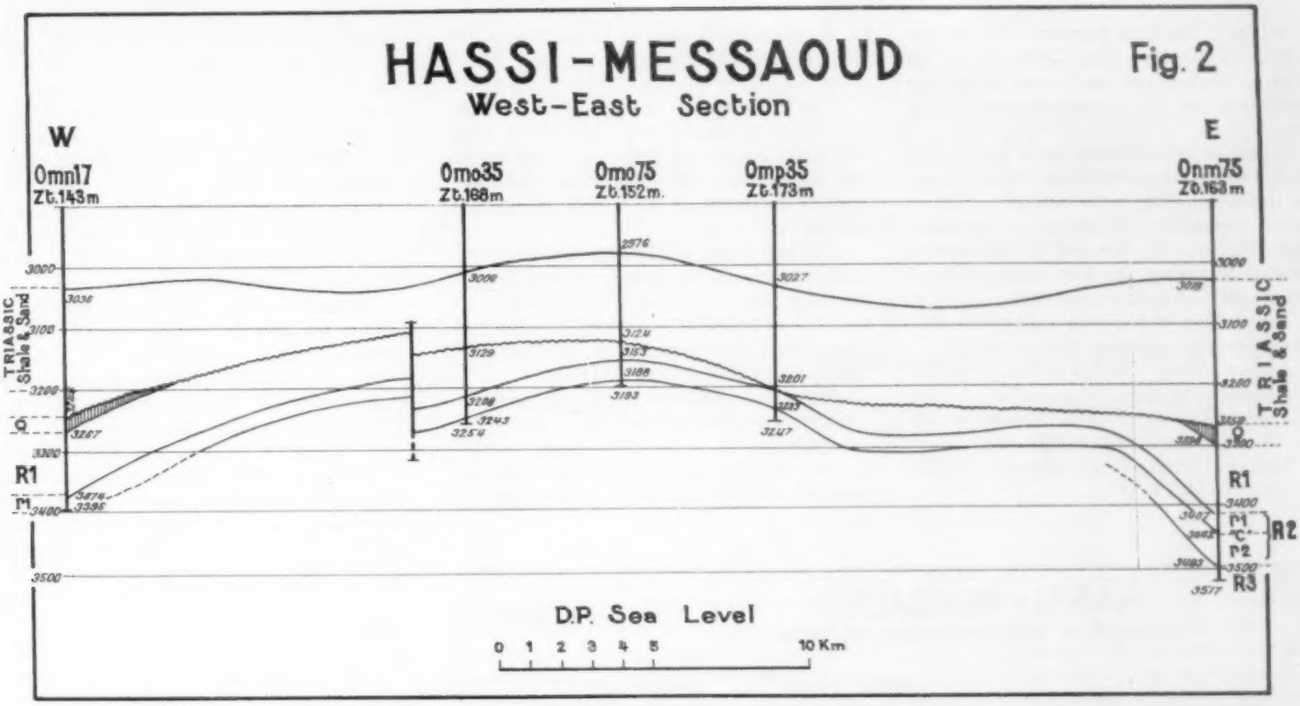
Porosity values average 11.5%; the permeability, which is about 10 md. in r_1, decreases and levels off at 1 md.(?) in the lower portion.

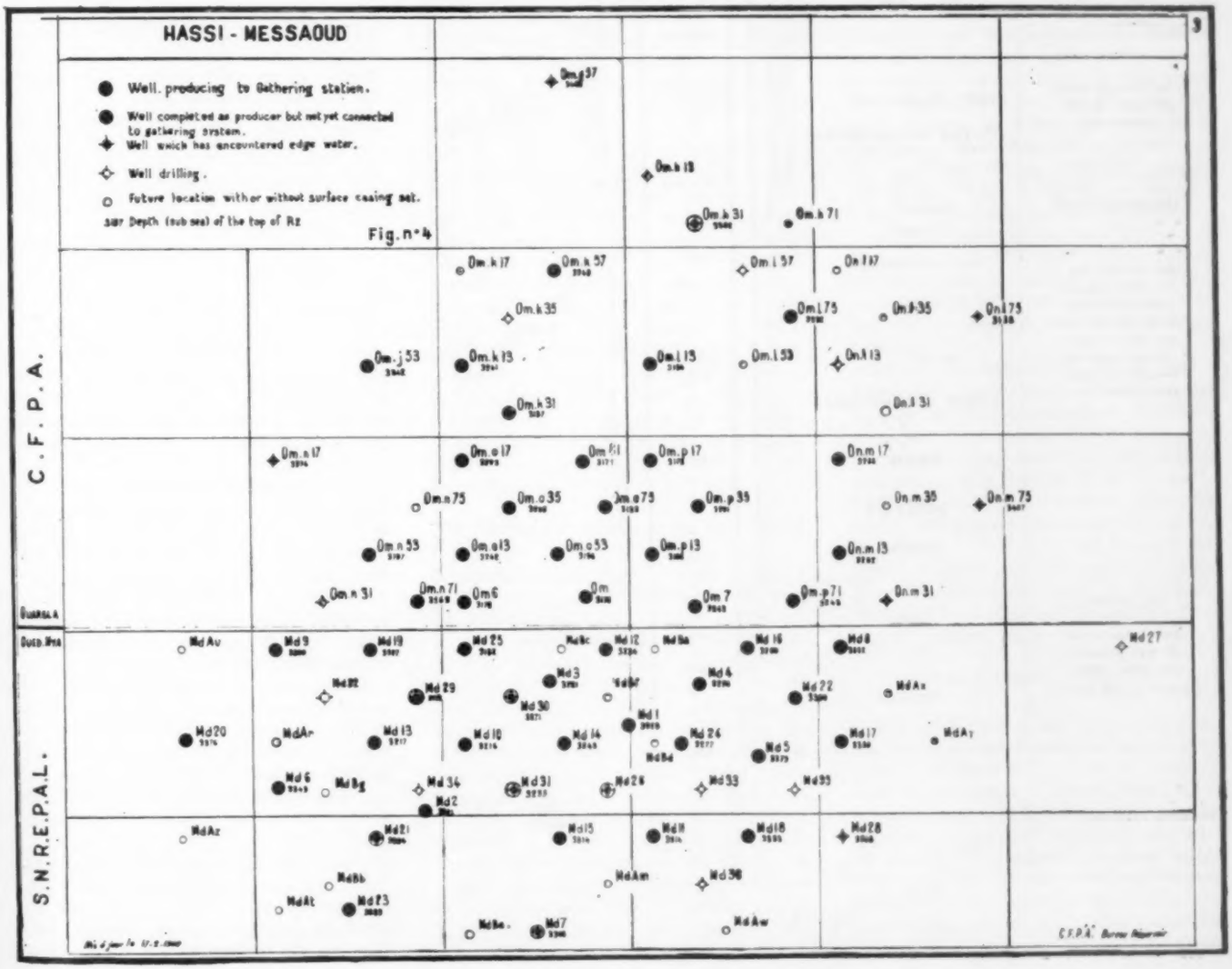
R_3 Zone: This zone which was completely penetrated in only three wells (Om 81-Omg 57-Md 2) has a thickness varying between 270 meters and 369 meters (891 and 1,218 ft.). It is characterized by coarse- to medium-grained sandstone (average particle size 500 μ, subangular) with very argillaceous cement (25% to 30% clay) in which illite has gradually replaced kaolinite. The silica cement amounts to only 2%. Feldspars also appear in this series becoming gradually more definite and more abundant near the base.

The average porosity is 11% and the permeabilities are generally less than 0.1 md. This zone nowhere presents any reservoir characteristics.

(*Continued on page 46*)




HASSI-MESSAOUD
Fig. 2
West-East Section
W
E
Omn17
Zt.143m
Omo35
Zt.168m
Omo75
Zt.152m.
Omp35
Zt.173m
Onm75
Zt.163m
TRIASSIC
Shale & Sand
R1
R2
R3
D.P. Sea Level
0 1 2 3 4 5 10 Km


HASSI - MESSAOUD
Well. producing to Gathering station.
Well completed as producer but not yet connected to gathering system.
Well which has encountered edge water.
Well drilling.
Future location with or without surface casing set.
Depth (sub sea) of the top of R2
Fig. n°4
C. F. P. A.
S.N.R.E.P.A.

Where it has been penetrated it rests on a granitic basement (Md. 2-Om 81) or on a series of fine red sandstones which are attributed to the Infracambrian (Omg 57).

Some 50 development wells have been drilled in the Hassi-Messaoud deposit since its discovery. The wells are now located at the intersections of a square development grid (Fig. 4). By the end of the current development stage the well density will be 8 wells per 100 square kilometers.

The drilling of the wells follows the following general program (Fig. 5):

Surface String 18-5/8—Down to 30 meters (99 ft.)

Technical String 13-3/8—Down to 150 to 250 meters (495 to 825 ft.)

Technical String 9-5/8—Down to 2,500 meters (8,250 ft.)

Production String 7—Down to 3,300 meters (10,890 ft.)

The reservoir is cored continuously in nearly all the wells, but a few wells were drilled through the reservoir as the result of mechanical difficulties. The depth at which the wells are bottomed corresponds to the base of r_1.

Oil and water muds were tried and are still being used depending on which portions of the reservoir are being drilled.

The completion program is that of permanent completion with the reservoir producing on an open-hole basis.

After the wells are completed, production tests are carried out over a period of one month.

The presence of an oil-water contact was revealed by five border wells, Omn 17, Omg 57, Oni 5, Onm 75 and Md 28. The depth of the oil-water contact varies with the capillary characteristics of the reservoir. It can, however, be stated that the average absolute depth of the oil-water contact is equal to —3,380 meters (11,154 ft.) with respect to sea level.

The oil under reservoir conditions has a specific gravity of .650 while at atmospheric pressure, it has a specific gravity of .8. The reservoir is of the undersaturated type.

From the results which have now been obtained it can be noted that the bubble pressure varies throughout the deposit within a range of 165-200 kg/cm² at the temperature of the reservoir, i.e. 118°C. The initial pressure is 483 kg/cm².

It cannot yet be stated whether all the oil contained in the deposit constitutes live oil, namely oil which plays a part in the production. It will appear that one can rely at this time on the possible existence of 2.5 billion tons of oil (reservoir conditions) (equivalent to about 19 billion barrels).

It is of course difficult to get a clear idea of the recovery factor until the development has been completed and until a precise notion of the behavior of the oil-water contact has been determined.

In addition to the characteristics already mentioned with regard to the oil, let us indicate a few characteristic P.V.T. figures for the Hassi-Messaoud crude.

1. Compressibility factor increasing from 2.10^{-4} $(kg/cm^2)^{-1}$ for the initial reservoir pressure (483 kg/cm²) to 4.10^{-4} $(kg/cm^2)^{-1}$ for the bubble pressure.
2. Solution G.O.R.: 250 m^3/m^3 (standard conditions).
3. Viscosity (reservoir conditions) .2 centipoises.

Productivity of the Wells:

As a result of the highly heterogeneous nature of the deposit, the productivity characteristics of the wells vary over a very wide range. While some of them can only produce a few tens of cubic meters of oil per day, others can reach outputs of several hundred cubic meters per day.

The productive potential of the wells cannot be ascertained precisely until additional data concerning the fields has been obtained and the behavior of the wells has been studied over a sufficiently long production period. However, the initial characteristics of the deposit have been deemed sufficient to bring about the construction of a 24 inch pipeline.

The coming years of production will undoubtedly complement and add precision to the data now available on Hassi-Messaoud. Studies have been undertaken regarding the possible use of secondary recovery methods in order to improve the recovery factor which can be expected from natural production.

Likewise, various methods of well stimulation are now being tested (Hydrofrac, acidification, etc.). They might result in modifying the well drainage efficiency and, therefore, the recovery factor. END

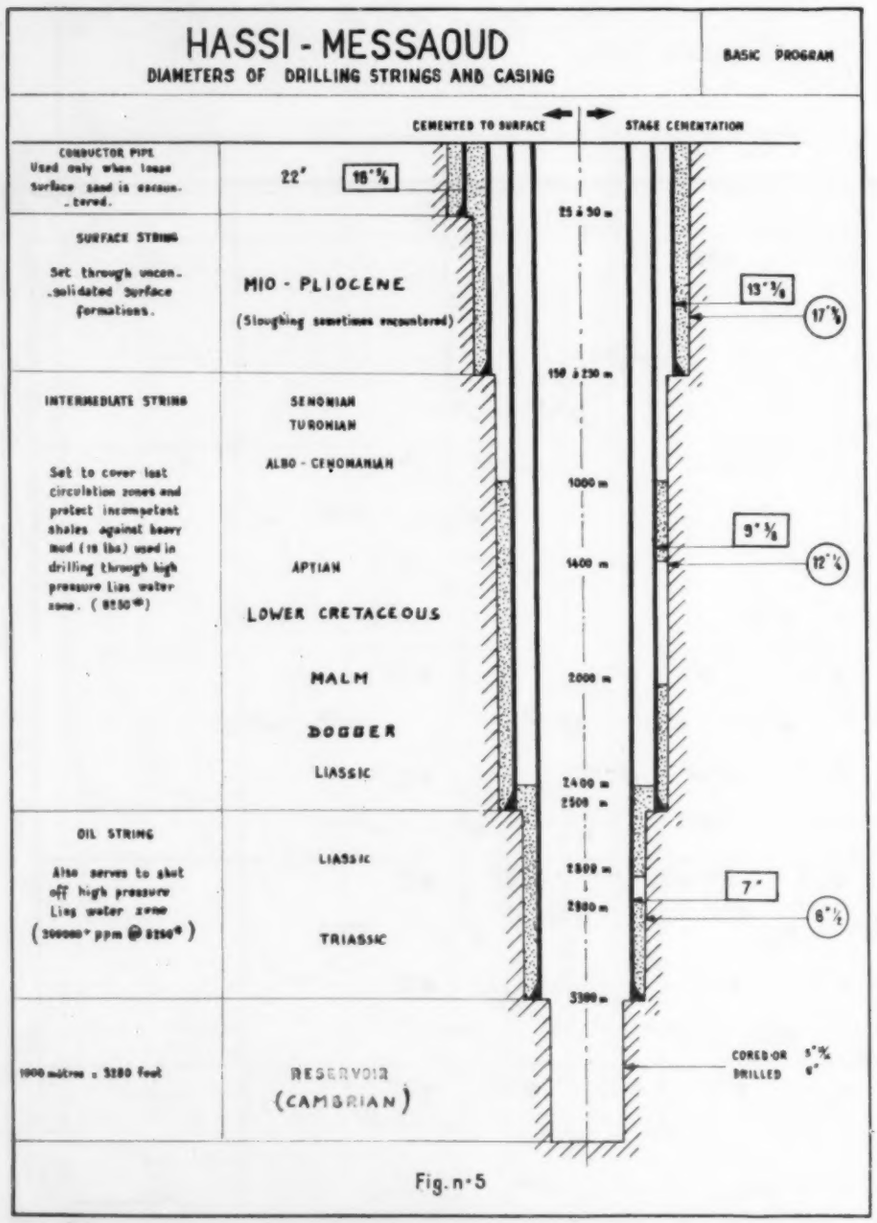


Fig. n°5

Levy sees "An Oil Age"

The coming decade will appropriately be known as "The Oil Age." The world's energy requirements will be easily met if low-cost development is allowed to proceed.

WALTER J. LEVY, ECONOMICS CONSULTANT in New York and a well-known figure in the international oil industry, has recently predicted that the coming decade will be known as "The Oil Age." In a statement before the Ottawa Branch of the Canadian Institute of Mining and Metallurgy, Mr. Levy recently pointed out the highlights of the world oil situation and made some significant predictions as to its future. There follows an abridged version of Mr. Levy's statement.

Introduction: We are indeed going through an extraordinary period of worldwide economic progress. There is every indication, however, that the past has only been a prologue and that we are just standing at the threshold of rapid economic advancement in the developed as well as underdeveloped countries of the Free World.

Such progress presupposes the availability of abundant and cheap energy. The oil developments in particular of the last few years give promise that an ample supply of energy can in fact be provided to all the various countries where it is needed at relatively cheap cost and without undue claim on their technical and financial resources. The next ten or twenty years therefore might well appropriately qualify as "the oil age."

Oil Requirements of the Free World

Estimates show oil demand of the Free World will increase from the present 19 million barrels a day to about 32 million b/d by 1970. Despite rapid and continued progress, however, the 1970 per capita consumption of energy in Europe will still be only one-third of that of North America; that of Latin America, one-eighth; and that of other Eastern Hemisphere countries, one-twentieth.

North America: Our estimates show an increase in oil consumption between 1960 and 1970 from 10.8 to 15.0 million b/d, a rate of about 3.4% a year as compared with nearly 4.6% in the previous ten years.

Western Europe: For Western Europe a more rapid expansion in oil requirements is indicated. We assume that European energy consumption is at a stage of development that is roughly comparable to that of North America between 1900 and 1929 and that accordingly, per capita energy consumption will grow by about 2.2%. For the near term, it would appear that the bulk of the increase in Europe's energy demand will have to be filled by imported oil. We have thus projected an increase in oil demand from 3.9 million b/d in 1960 to 7.2 million b/d by 1970.

Underdeveloped Areas: In Latin America, Africa and Asia, energy use is at such low levels that per-capita energy consumption now is only at about a tenth of what it was in North America in 1900. We have projected growth in per capita energy consumption at about 4.4% annum, the rate that obtained in North America from 1900-1913. The rates of growth implied by our projections between 1960 and 1970 are 8.3% a year in Latin America, whose consumption will advance from 1.7 to 3.7 million b/d, and 8.7% per annum in Asia, Africa and Oceania, where demand will advance from 2.5 to 5.8 million b/d.

Oil Production Trends in the Free World

North America: In the United States, the rate of finding new oil has been declining; on the other hand, improvement in methods of recovery could literally multiply the producibility from existing and future reserves. In Canada, there has been a fairly steady increase in additions to reserves. In view of the many uncertainties, we take recent increases to gross reserves in each country as a plausible indication of future additions. These add up to 3.9 billion barrels a year. Together with existing reserves, and on the basis of a 13-year reserve-to-production ratio, North American resources would thus support production of 9.9 million b/d by 1970 as compared with 8.9 million b/d in 1960. This would represent expanded production at the rate of 1.1% per year, compared with 4.9% between 1950 and 1960. Significantly, North American production would then fall short of consumption by over 5 million b/d. In consequence, import requirements would mount to around 34% of total consumption, as against some 18% in 1960.

Latin America: In Venezuela, both exploration and development have been slowed. On the other hand, the oil search is being aggressively pursued in other countries, from Mexico to Argentina. On balance, we take as a plausible assumption that future discoveries will be in line with the experience of the 1950-1960 decade, adding some 2 billion barrels per year.

Allowing for a decline in the reserve-to-production ratio, we estimate 1970 Latin American production at 5 million b/d as compared with 3.6 million b/d in 1960—an increase of 3.2% per year between 1960 and 1970, compared with 6.3% between 1950 and 1960.

Eastern Hemisphere: We project Eastern Hemisphere production at a rate sufficient to meet its own consumption plus North American import needs. On this basis, output would increase from 6.1 to 14.7 million b/d during this decade, or at a rate of 9.2% per year. North African production in this total may rise from some 200,000 b/d to over 2 million b/d. All through this period, however, production potential in the Eastern Hemisphere is likely to exceed the projected level of actual demand for Eastern Hemisphere crude.

The Problem of Surplus

For the United States, projections point to the possibility for significant improvement in domestic oil markets, as compared with the problems of recent years. While the rate of growth in consumption may be modest, the absolute increase in the level of requirements would be very large—probably well beyond the ability to expand domestic production. Accordingly, we would expect that import limitations would be relaxed to permit foreign supplies to fill

the gap between domestic requirements and supplies.

In time, the allocation of import quotas is apt to move increasingly toward a refinery-run basis, with historical importers losing much if not all of their preferential position. Significantly, the major expansion in imports is likely to take place East-of-the-Rockies. On the West Coast, a slower rate of growth in consumption plus increased crude supplies from offshore, Canada (and possibly Alaska) should combine to hold import requirements to a level not too much above the present.

The Outlook for International Markets

Despite rapidly rising oil consumption, the prospects for markets outside the United States are far less sanguine than the domestic outlook. Development of new producing fields and by new producing companies and increased producibility in present export areas all suggest that the crude oil surplus will persist well into the Sixties. At the same time, surplus refining and tanker capacity is also likely to continue. In consequence, market competition will become increasingly intense, both crude and product prices will be under pressure, and the margin of profitability is apt to narrow.

New Producing Areas: New producing areas are now at the point of large-scale development, most spectacularly in North Africa. The implications of expanded Sahara production mean an increasing displacement of Middle East and some Venezuelan crude. Meanwhile, each company would want its Sahara liftings to include as much of its own Sahara or other French origin crude as possible. This could result in added impetus for a more rapid Sahara development by individual companies in order to protect their competitive position.

Libya already promises to become a major producing region in the near future. Libyan crude has four distinct advantages. From all indications, it will be low-cost oil, at least for those companies who are fortunate enough to hold favorable concessions. By virtue of location, it can also command a price premium over Middle East crude. For most of the concession-holders, it further represents control over substantial reserves which can be drawn upon freely without risking overlifting that may be involved in joint concessions in the Middle East. Finally, the Libyan legal and tax system is comparatively attractive.

The price of Libyan crude may actually be established below the point of competitive equalization with Middle East crudes. This would place Middle East oil at a disadvantage and could lead to crude price adjustments there. In this event, Middle East producing profits would be generally reduced. The resulting reduction in the income of Middle East governments might lead to requests for higher taxes similar perhaps to those in Venezuela. This would further affect the profit rate of the companies on Middle East production.

Any reduction in Middle East crude prices will add to the competitive disadvantage of Venezuelan crude. Significantly, the Venezuelan government is actively pressing for international prorationing among major producing countries; and has repeatedly stressed that it is more concerned with maintaining the price of its oil than with expanding production. In the course of intensified world competition, however, Venezuela could suffer in both respects, having to take a reduction in prices while at the same time lagging in production. Thus, Venezuelan Government revenues might well be adversely affected despite the increased tax rate. While the Venezuelan government might find it politically impossible to rescind the new tax rates, it might conceivably try to restore the attractiveness of its oil by granting tax credits against company re-investment of earnings within the country or through other means.

Such a move would restore stability to the 50-50 tax arrangements still in effect. If, on the other hand, Middle East taxes should also be increased, then the competitive disadvantage of Venezuelan oil would be diminished. Such a move would of course reduce the profits of all companies.

New Producing Companies: In addition to the incoming production from new areas, companies that have only recently embarked on foreign ventures will also have to find markets for their new production. In consequence, Lake Maracaibo oil is being offered at prices considerably below comparable postings. In the Persian Gulf, newcomer companies such as ENI and Indiana Standard will be faced with parallel problems as they develop their concessions. The Japanese company operating a Neutral Zone off-shore concession has recently announced the discovery of oil. It is not impossible to conceive that the home governments may interfere, as France did, to give the newly-found oil an outlet.

Refining and Tanker Surplus: The majors are also being forced into refinery construction in many areas to protect their market positions.

We thus note a significant trend toward the construction of refinery facilities in consuming countries. Refinery outlets have become the key to profitability of very large investment in crude oil production.

The scope of expansion is evident from current plans for new refining capacity. In Europe almost 600,000 b/d in new plants are to be added in 1960, and another 560,000 b/d are already scheduled for subsequent years. For the rest of the Free World outside of North America present plans call for another 300,000 b/d of new capacity in 1960; over 1 million b/d thereafter.

Contraction of Crude Outlets: While a rising volume of crude oil is seeking markets, many consuming countries are making concentrated efforts to find indigenous oil; their success would tend progressively to reduce import requirements. We should also note that government policy is tending increasingly to preempt markets in order to protect local crude oil production. As examples, witness U.S. import limitations, preferences for "national" oil in France and elsewhere, and trade agreements based on barter or other special considerations.

The Question of Soviet Oil

Soviet Oil is also impinging on available markets. The production of the Soviet Union has increased greatly during the last few years and amounted in 1959 to 2.6 million b/d. The Soviet plan figure for 1965 is about 4.6-4.8 million b/d. At the same time, Soviet exports have risen not only to Eastern bloc countries, where they amounted to over 160,000 b/d by 1958, but also to other areas, where they reached nearly 200,000 b/d.

An expanding Soviet oil trade adds to the uncertainty in world oil markets. However, I believe that none of their actual or potential Western customers would like to become too dependent on Soviet oil or on the terms under which they might be supplied if they should ever risk such dependency. In addition, Soviet oil resources are increasingly needed in the Soviet Union.

The Availability of Oil in The Long Run

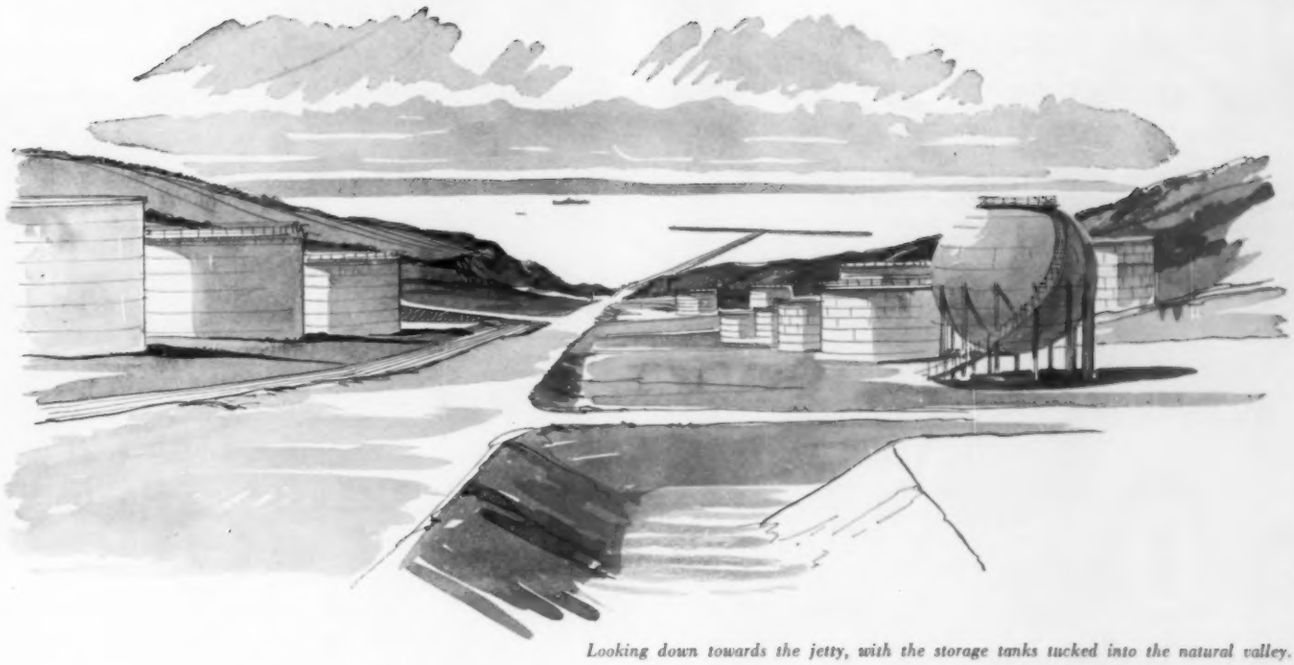
The important question that remains now to be answered is whether problems of oil surplus may not give way to concerns about the availability of oil towards the end of the present decade.

Eastern Hemisphere sources are called upon to supply some 41 billion barrels of oil to meet that area's consumption needs plus Western Hemisphere deficits between 1960 and 1970. Relying solely on oil reserves as published at the beginning of 1959, Eastern Hemisphere producers could fill all these requirements and still be left with a 23 years' supply in 1970.

In the Western Hemisphere, our projections require discoveries totalling 58 billion barrels from 1960 to 1970—39 billion in North America and 19 billion in Latin America. Whether these levels can be achieved depends partly on geological prospects, and partly on the pace of future exploration activity.

In summary, our production estimates for the Western Hemisphere are derived from projections of reserves which may be regarded as reasonably attainable. They do not contemplate an abrupt drop-off in U.S. producibility, but neither do they depend on a sudden sharp improvement in finding and recovery rates. For the Eastern Hemisphere, we do not even need to take account of discoveries of new reserves—and they are likely to be substantial. Nevertheless, our production needs can be met out of proven reserves, with large resources left over by 1970 for future production. World oil resources can thus easily meet all requirements and if commercial and competitive efforts are permitted to proceed reasonably freely—at low cost. The Sixties can therefore be truly characterized as The Oil Age

END



Looking down towards the jetty, with the storage tanks tucked into the natural valley.

Progress at Milford Haven

Construction of Esso Petroleum's new 100,000 b/sd refinery in Wales stays on schedule. Accent is on "social engineering" in design, layout and landscaping

by Cecil W. Wood

A RECENT VISIT to Milford Haven (Pembrokeshire) afforded ample evidence that construction of Esso Petroleum Co.'s 4½ million ton p.a. (100,000 b/sd) refinery, expected to cost £18 million, is in an advance state and on schedule. The first cargo of crude is due to arrive in mid-1960 with the refinery working up to full steam from September onwards, and by the start of 1961, deliveries should be flowing to Esso's marketing installations.

For the refinery proper the main contractor is Foster Wheeler Ltd. The other principal contractors are: George Wimpey & Co. Ltd., site grading and buildings; John Mowlem & Co. Ltd., marine terminal; and Motherwell Bridge & Engineering Co. Ltd., Wm. Neil & Son (St. Helens) Ltd. and Whessoe Ltd., tankage.

The reason for this new refinery is that Fawley—with a 10½ million ton capacity—is now regarded as having reached the maximum economic size Esso feels it ought to have in one location. Milford Haven, perhaps, will eventually reach the size of Fawley.

From the inception of the project, which is sited in a rural area of Wales of great beauty, Esso has felt strongly that it had a "social engineering" task to do which was as important as the "physical engineering," especially as the refinery borders a National Park. Ample evidence is seen that it has striven hard to this end, and is succeeding, and the refinery manager, E. Asquith, pays warm tribute to the excellent relations reached with the local population and the help received throughout from all the authorities concerned.

A striking feature is the way the greater part of the plant and tankage has been fitted to the contours of the site as they drop towards the Haven and "let into" a natural ravine. Surprisingly little is to be seen from the land side or from the water, credited as largely due to the imaginative advice received from S. Colwyn Foulkes, OBE, the well-known professional landscape architect. The aim is to make the refinery a model for future industrial developments in rural areas. In fact, the refinery is claimed to be the first in the world to have been constructed with the advice of a professional landscape architect. Civil buildings, too, have been designed by Sir Percy Thomas & Son to blend with the surroundings. It is hoped that in due course, the Forestry Commission will find trees suitable for planting so as to further screen the refinery.

The plant occupies 350 acres of the 1,100 owned by the company and this "concealment" policy has entailed a major terracing operation, soon to be complete except for finishing touches, involving the movement of about a million tons of earth. The portion not occupied by the plant is being farmed to the maximum. Some 7½ miles of road have been made and their base course consolidated, awaiting final asphalt finish when heavy construction work is over. Sub-surface work is finished and surface drainage ditches were seen being "gunnited" with cement for consolidation. Although most of the refinery output will go by sea, in conjunction with British Transport Commission a rail link is also being provided.

Storage tank and pressure sphere construction is in an advanced state; some have already been hydrostatically tested and are ready for service. There will be 68 tanks, 40 of which will have floating roofs. The nine crude tanks, 54 ft high by 150 ft diameter, each with a capacity of 25,000 tons

(170,000 bbl), will allow for 13 days' normal plant operation. A feature of the tanks in some locations is the absence of the usual "bunds" or fire walls. Where suitable, "directional walls" have been installed to lead any leakage toward the skimming pond separator.

Construction of the 100,000 b/d pipestill is well up to schedule. Its furnace will be the largest of its kind in the world, matched only by that at Esso Nederland's new Rotterdam refinery, with a heat output of 465 million Btu/hr.

Milford Haven will be the first refinery in Britain to be air cooled throughout and the coolers on the distillation unit are almost completed and are being "cocooned" until required. The three further coolers on the Hydrofiner are complete and parts of the processing equipment are well advanced. Much equipment for the Powerformer was seen on site, but work on the two Foster Wheeler boilers, each of 130,000 lb/hr at 150 psig and 450 F and the associated water treating plant, is still in the early stages.

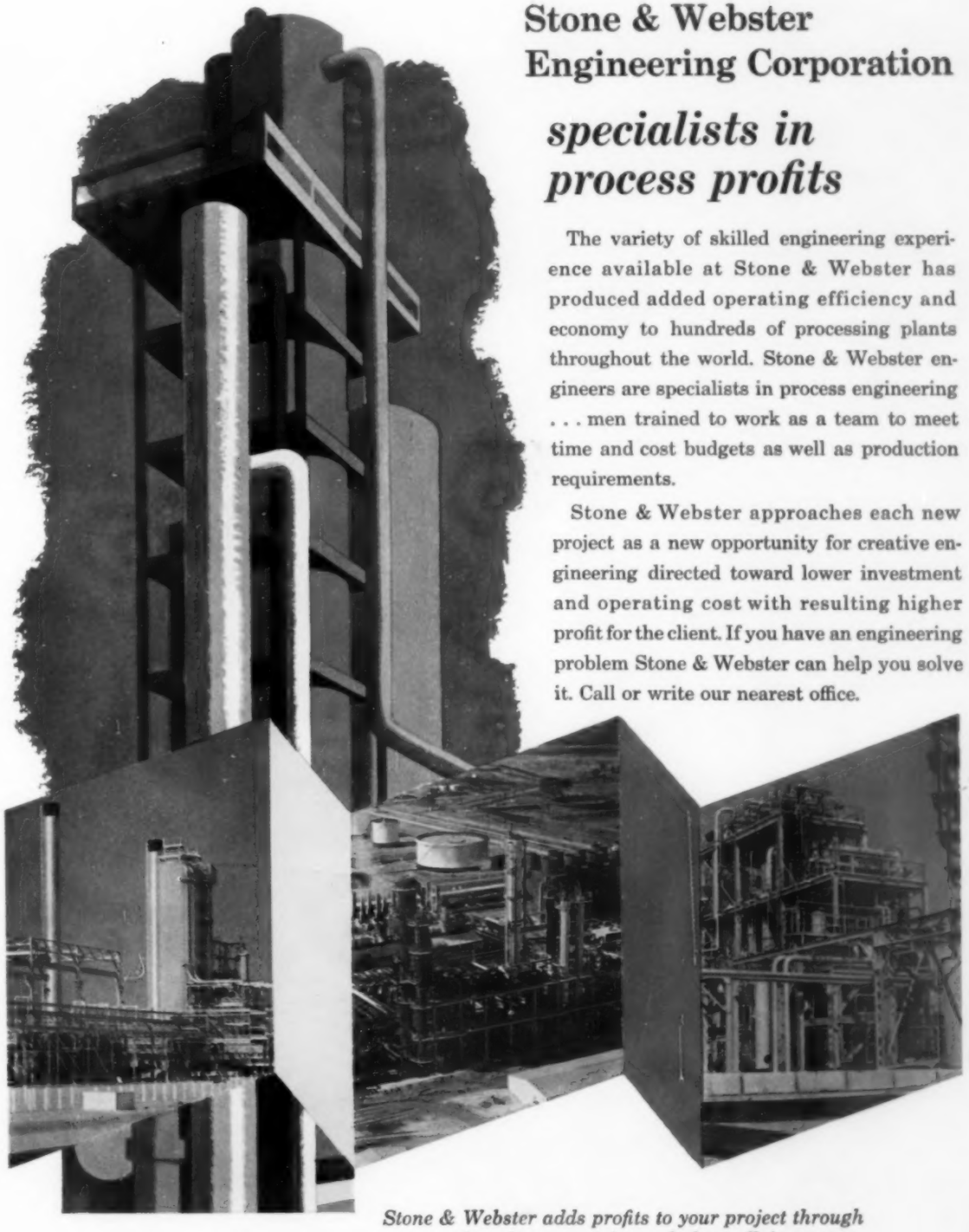
An unusual refinery feature is that there will be only one processing area control room; equipping this is well advanced and it now awaits its graphic panel. It is claimed Milford Haven will be one of the most highly automated in Europe; by this means, operating costs will be cut and Esso aims to be truly competitive in Europe as in the U.K.

Adoption of air cooling is regarded as one of the major technical advances made by the company in recent years, not only because it reduces maintenance costs but also because it reduces the risk of marine pollution. Particular attention has been paid to this problem as part of the "social engineering" aspect. In addition to the standard API separator, a natural ravine has been dammed to form a second line of defense, with a normal capacity of 5¼ million gallons, or 10 million in an emergency. Into this will go all refinery surface drainage water and water from the primary separator and, in emergency, oil from a tank failure. Clean water will eventually reach the Haven below its low water mark through a 48-inch line. Another precaution is the provision of an oil-containing boom and a specially designed oil recovery vessel for emergency use in the Haven. The pipestill furnace chimney stack is 300 ft high to minimize air pollution. A 50 ft high, totally-enclosed, multi-jet ground flare—another new Esso development already installed at the Whitegate (Cork) refinery—will give 100% combustion of excess refinery gases. This is claimed to be smokeless, noiseless and nonluminous.

Mr. E. Asquith, manager of Milford Haven refinery.

The final link in the 36-inch crude line to the marine terminal is awaiting completion. This terminal deserves special mention as it is regarded by the firm responsible, John Mowlem & Co. Ltd., as a major engineering feat and believed probably unique. Its tee shape extends 3,500 ft into water with a natural depth of 40-60 ft, both in the approach channels and at the berths. The two outer berths will be capable of taking 100,000 ton tankers, and the inside

The general layout of the refinery in relation to the contouring of the ground.



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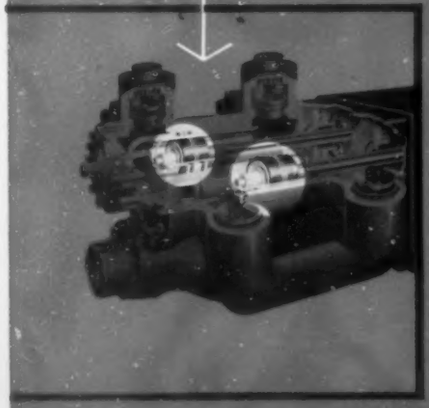

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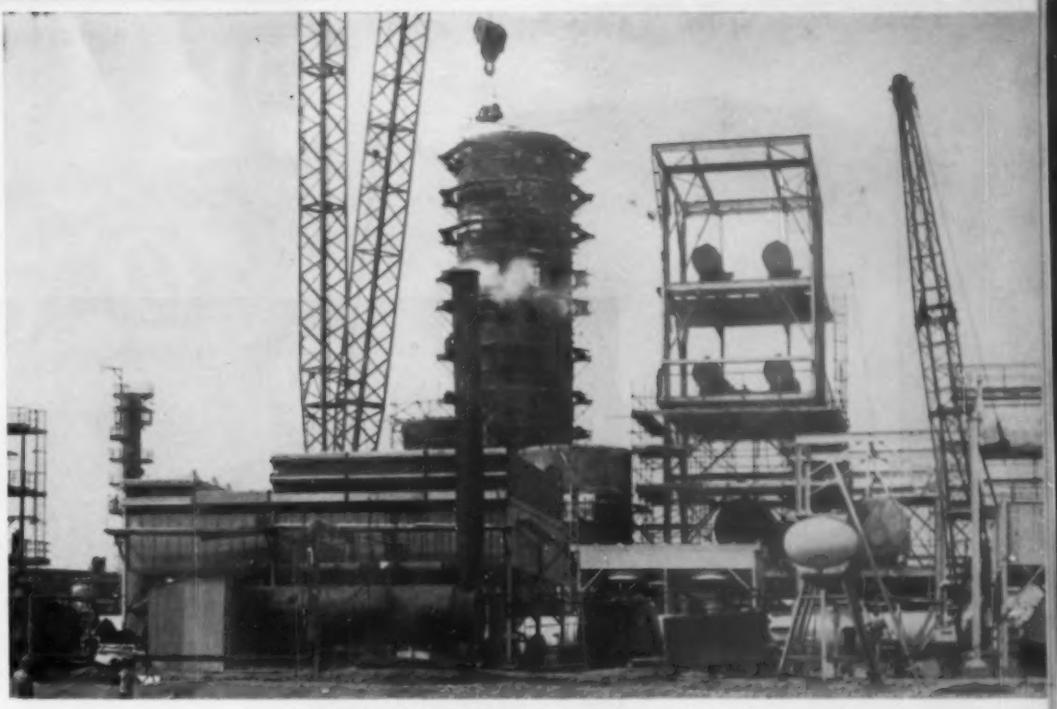
60—500

Top section of Hydrofiner reactor, which weighs 40 tons, being lifted and guided into position for welding to bottom section.



Above: Distillation facilities; furnace at left, air fin cooler at right, and fractionation tower rising in background.

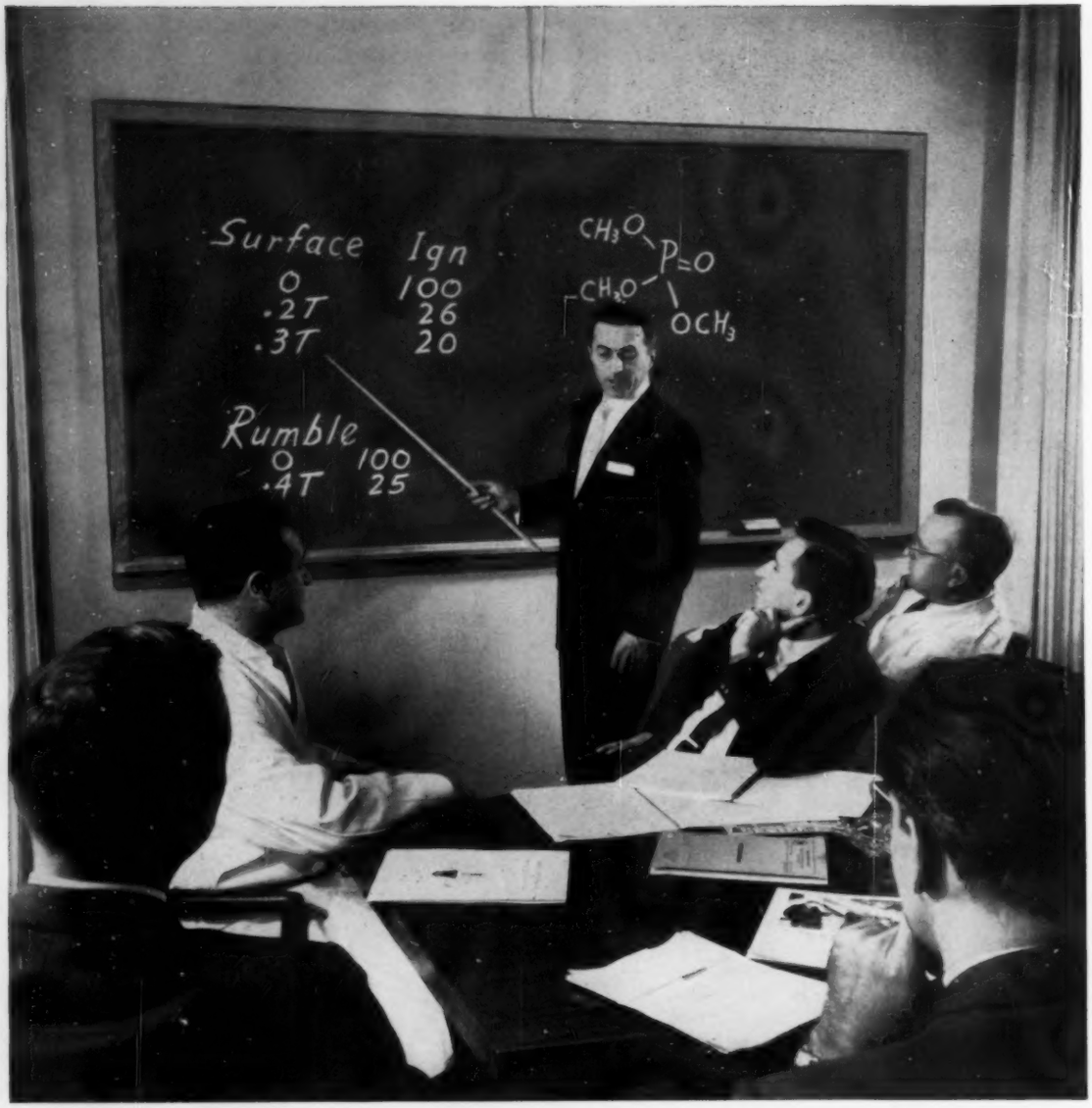
berth up to 5,000 ton coastal vessels. Terminal planning has allowed for future expansion. The approach trestle has also been designed to allow local fishing craft to follow their customary inshore passages.

The outstanding feature of this structure is that it consists almost entirely of prestressed, hollow cylindrical piles, manufactured by a process developed by Mowlem and made at a special plant near the refinery. The concrete piles range from 35 to 143 ft in length—the longest ever made in Britain—and weigh up to 18 tons, with diameters ranging from 22 to 27 inches. The piles, prestressed to 57 tons to the sq in, have been cast simultaneously in parallel beds in continuous lengths up to 500 ft; these are fitted with dividers to give the required individual pile length and cured before transporting in Mowlem's own vessels to the marine terminal itself. At the terminal, up to eight of the biggest piles have been driven in a day through 10 fathoms of water and 50 ft of silt, sand and gravel to bedrock by the 95 ft piling frames fitted with 10-ton hammers. This is felt to be quite an achievement in view of the accuracy of positioning and length required. Both precast targets of 100,000 linear feet of piling (some 19 miles) and 90,000 cu ft of unit and road slabs have now been reached, and 700 miles of 0.27 inch diameter prestress wiring have been used.

Another interesting point learned from this visit was that the Milford Haven refinery will be composed almost entirely of British-made equipment; it is understood that only two compressors and some reactors were purchased from the USA or the Continent. The primary impression of the visit, however, was the accent on "good neighborliness," a policy which will leave a beautiful part of Wales as unspoilt as possible, but which is bringing, and will continue to bring, more local benefit. For Esso's aim is that this Pembrokeshire refinery shall be run by Pembrokeshire people. END

Above: The concrete prefabricated section and pile casting yard.

Completed grading, tank foundations, and tank and process unit under erection.



THE NEWEST AND MOST ECONOMICAL PHOSPHORUS ADDITIVE!

"Ethyl" Ignition Control Compound 4 provides more phosphorus per pound at a lower cost

A NEW ECONOMICAL PROCESS for manufacturing ICC 4 (trimethyl phosphate) now provides refiners with the lowest cost phosphorus protection. Thoroughly tested in both laboratory and field, it proved its effectiveness as a gasoline additive and had no undesirable side effects.

A new plant for manufacturing ICC 4 has been completed at Baton Rouge, La., and commercial quantities are immediately available. This phosphorus compound is an exclusive Ethyl product and its use as a gasoline additive in the United States is covered by patents.

Effectiveness of "Ethyl" ICC 4

Ethyl Research tested the effectiveness of ICC 4, in gasolines containing 3.0 ml. of tetraethyllead per gallon, as a suppressant of surface ignition and rumble, and as an extender of spark plug life. In every case, ICC 4 proved to be equally effective with other phosphorus compounds on the market, and showed a marked improvement in cost effectiveness.

Surface ignition tests were made in single-cylinder engines.

Phosphorus	Relative surface ignition counts, %
None	100
0.2 theory ICC 4	26
0.3 theory ICC 4	20

Rumble frequency was tested in a V-8 engine with a 12 to 1 compression ratio.

Phosphorus	Rumble, % of observations	Mileage Accumulations
None	100	8,000
0.4 theory of ICC 4	25	9,500

Spark plug life was tested in V-8 engines operated on a dynamometer.

Phosphorus	Relative life to fouling, %	
	Engine A	Engine B
None	100 (27 hours)	100 (32 hours)
0.2 theory of ICC 4	330 (89 hours)	355 (114 hours)

No Deleterious Side Effects

Exhaustive tests in current fuels show that ICC 4 has no undesirable effects on gasolines or engines:

1. Low antiknock destruction.
2. No effect on intake system deposits.
3. Satisfactory exhaust valve durability.
4. No effect on pistons, rings, or bearings.
5. No effect on storage stability of leaded gasolines.
6. And ICC 4 is compatible with other gasoline additives.

Solubility a Minor Factor

Because ICC 4 is water soluble, some phosphorus is extracted from gasoline into water contained in storage and pipeline systems, of course. However, losses are small and economies are only slightly affected.

Extractability studies indicate that initial losses will be small in routine blending or storage operations. Moreover, the concentration in water bottoms will slowly reach equilibrium with the concentration in gasoline: thereafter losses will be negligible. Losses are greatest when ICC 4 is first introduced.

Economics of "Ethyl" ICC 4

Ethyl has studied typical refining situations to establish the savings that can be made using ICC 4 as a substitute for phosphorus compounds that are less water soluble. Evaluations carefully allowed for losses in blending, storage and service station tanks.

First year savings range from 10 to 15% of total phosphorus additive cost. Greater savings are made when water bottoms achieve equilibrium or are eliminated.

How Ethyl Research can help you

Like all "Ethyl" products, ICC 4 is backed by a full complement of technical and research services. If you wish, your Ethyl Representative will arrange for technical specialists to assist you in determining its most economic use in your refining situation. He also will be glad to supply you with detailed technical literature.

Samples are available now for test purposes from your Ethyl Representative, or by writing to Ethyl Corporation Research Laboratories, Technical Service Department, 1600 West Eight Mile Road, Ferndale 20, Michigan.

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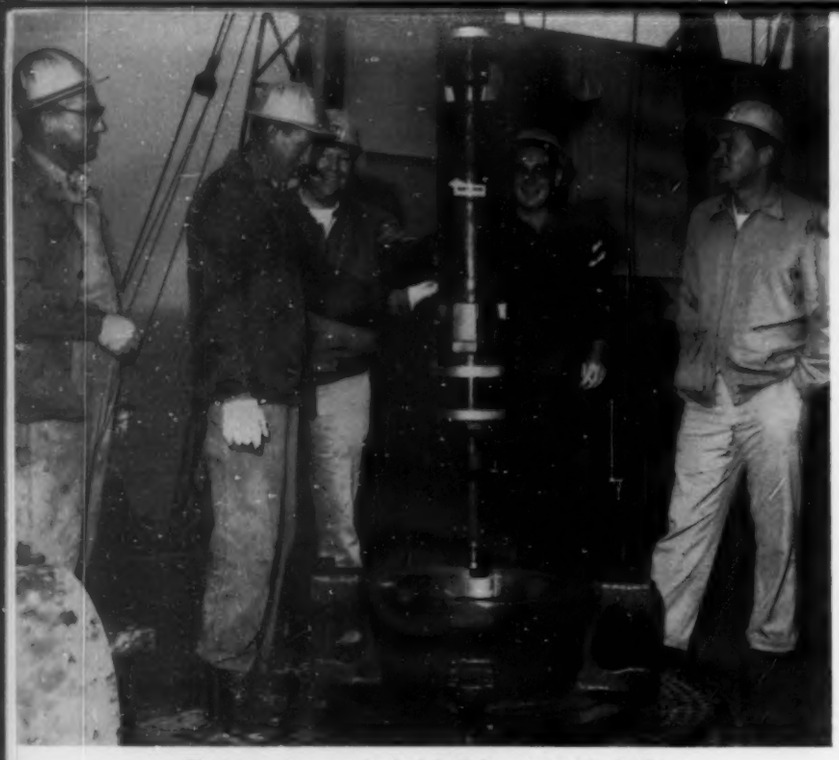
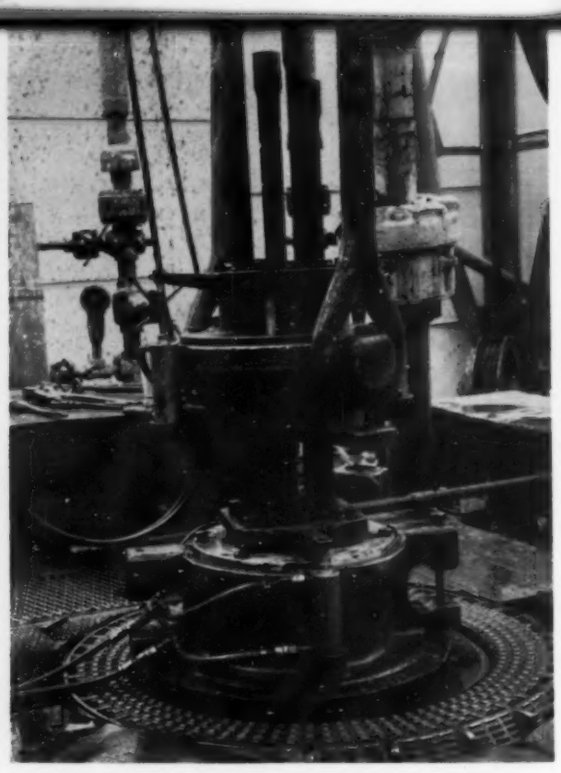


The first packer starts in the hole. Left to right: John R. Feeser and Norman Rogers of Brown Oil Tools, and L. G. Buchanan, Walt Candall and Bill Roark, all of Sinclair Oil & Gas Co.



Power-actuated multiple string slip-type elevators and power-actuated multiple string tubing slips used in running the tubing.

The world's first quintuple producer

Sinclair oil & gas co., producing subsidiary of Sinclair Oil Corp., and associates have completed the oil industry's first quintuple producer, Well No. 6 Block 190 in the Eugene Island area, 40 miles off the coast of St. Mary Parish, Louisiana, in the Gulf of Mexico.

Five parallel 2-in. tubing strings with six packers were run inside the 9⅝-in. casing. Sinclair has completed the well in six zones, five of which may be produced simultaneously. On calculated open-flow potential tests, six zones of the Pliocene formation from depths of 6,156 to 7,104 ft produced at the rate of 492 mmcf/d.

The discovery well was drilled in 72 ft of water from the mobile offshore platform "Julie Ann," owned by Dixilyn Drilling Corp. of Odessa, Texas, using a National Supply Co. Type 1625-DE rig. The producer is about 1,000 ft southwest of Well No. 5 which was quadruply completed in deeper sands.

The federal lease block is owned one-fourth each by Sinclair, the operator; El Paso Natural Gas Co., Sohio Petroleum Co., and Peoples Gas Light and Coke Co. The partnership operates two other producing wells on the 5,000-acre block.

B. R. Roark, division petroleum engineer for Sinclair's New Orleans division, and L. G. Buchanan, district petroleum engineer, designed the general installation. Various supply companies designed individual pieces of equipment. National Supply Co. furnished the wellhead equipment, and Brown Oil Tools Co. designed the six packers.

The five tubing strings will permit Sinclair to produce five zones at the same time. The No. 2 zone is isolated by the additional packer to allow this zone to be produced alternately with No. 1 zone or when the lowest sand has been depleted. This may be accomplished by setting a tubing plug above the depleted sand and opening a circulating sleeve in the tubing opposite the alternate zone.

The six producing Pliocene sands and their calculated open-flow potentials are: No. 1—102 mmcf/d of gas from perforations at 7,092-96 and 7,100-04 ft; No. 2—106 mmcf/d from perforations at 7,055-62 ft; No. 3—59 mmcf/d from 6,968-72 ft; No. 4—69.5 mmcf/d from 6,830-36 ft; No. 5—30.5 mmcf/d from 6,359-65 ft; and No. 7—125 mmcf/d from 6,156 ft.

The "Christmas tree" was designed, assembled, and tested at the Houston plant of The National Supply Co. It includes a tubing spool, tubing hanger, quintuple port flow tree, crown member, and flow fittings manufactured by National; and a master valve assembly, consisting of two quintuple ported block valves supplied by Cameron Iron Works. The Spang tubing was manufactured at National Supply's Ambridge, Penna., seamless tube mill.

From the bottom of the tubing spool to the uppermost flow line plugs the tree is 10 ft 1 in high, and it weighs approximately 9,100 lb. All five tubing strings were run simultaneously and not strapped together. After the tree was installed and the mud displaced from the strings, hydraulic packers were set and actuated selectively by applying differential pressure across each one. This was done by pumping a ball or plug down the tubing string until it seated in the packer. Application of a predetermined amount of additional pressure above the ball energized the packer. After the packer was set, the ball was recovered by well flow or by reverse circulation .

The well was drilled vertically from the self-elevating offshore platform. The 9⅝-in, 47 lb/ft production string casing was set and cemented. It was decided to equip the well with five strings of 2⅜-in tubing. A total of six Brown Oil Tools Retrievable Hydraulic Set Packers were run. Two single string Type HS-16-1 packers were run and the two lower zones were completed as alternate zone completions (see Fig. 1). When Zone A is depleted a plug will be run in the No. 1 tubing string and landed in the landing nipple to blank off the lower zone. The sliding sleeve opposite Zone B will be opened and this zone produced through the No. 1 string. This operation will be performed by wire line and it eliminates the need for costly offshore workovers when Zone A is depleted.

Five of the six packers are provided with a hold-down feature to prevent communication between zones when subjected to differential pressure below any packer. A hold-down was not included on the upper packer as it was not needed.

Initial preparation. The quintuple string Retrievable Hydraulic Set Packer had already been built and tested by Brown Oil

Tools. It is a further development of such packers which have been run in dual, triple, and quadruple string completions.

The completion of a quintuple parallel string was made feasible by the technique of simultaneously running five strings of tubing. As the number of parallel tubing strings run in the same bore hole has increased, difficulty has been experienced in the past, especially in deviated holes, in running and stabbing auxiliary strings in the upper packer. To eliminate this undesirable stabbing feature, Brown Oil Tools pioneered and manufactured the first set of power-actuated multiple string slip-type elevators. A power actuated multiple slip bowl was also manufactured to retain the five tubing strings in the rotary table while running the tubing.

Running Packers. To prevent any loss in rig time while running the packers and tubing strings, sufficient tubing was tallied for the tubing needed below the Quintuple Hydraulic Set Packer. Then, with the tally available, the spacing was worked out on paper before the job was begun.

The first packer, a Retrievable Brown single string Type HS-16-1 Hydraulic Set Packer was started in the hole on Monday, February 29, 1960. Immediately above the packer a landing nipple and flow coupling were run. The landing nipple serves as the means to locate and land a plug for blanking off the lower zone when it is depleted at a later date. Next in the string is a rubber sleeve abrasion or blast joint to protect the tubing opposite the producing zone from sand-laden gas which can, in effect, "sand-blast" holes in the tubing which can in turn create communication problems between zones. Next, a sliding sleeve was run in the closed position. This sleeve can be opened by wire line operation when it is desired to produce Zone B after Zone A is depleted. Sufficient tubing was run for correct spacing and then another Type HS-16-1 packer was made up in the No. 1 string. Immediately below this packer a Brown Type CC "Criss-Cross" Safety Joint was first placed in the string. The safety joint is used to aid, if necessary, at a later date, the removal and retrieving of the packers.

The same equipment was run above the second HS-16-1 packer. More tubing was run until it was time to put another "Criss-Cross" Safety Joint in the string followed by the Type HS-8-2C Retrievable Hydraulic Set Packer. This packer is equipped with the hydraulic hold-down.

In producing multiple completed wells quite often one zone is shut-in while another is producing. Thus, differentials occur across the packers used in these installations. When the zone pressure below the dual packer, for example, exceeds the zone pressure above the dual packer, the hydraulic hold-down buttons move out and engage the casing wall. The hydraulic hold-down buttons are actuated by the zone immediately below the dual packer and move out and grip the casing wall, thus, they prevent the packer from unseating.

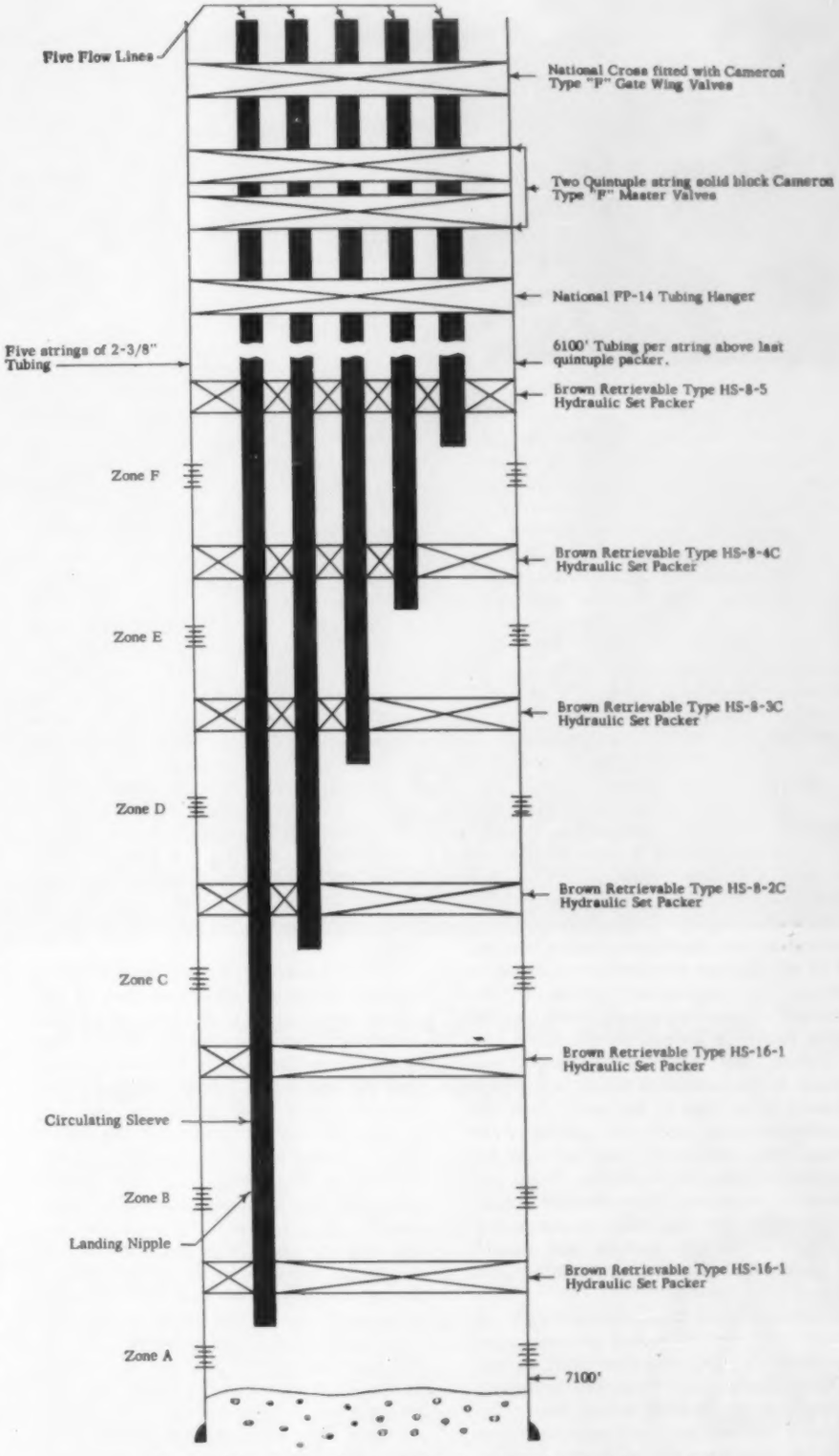
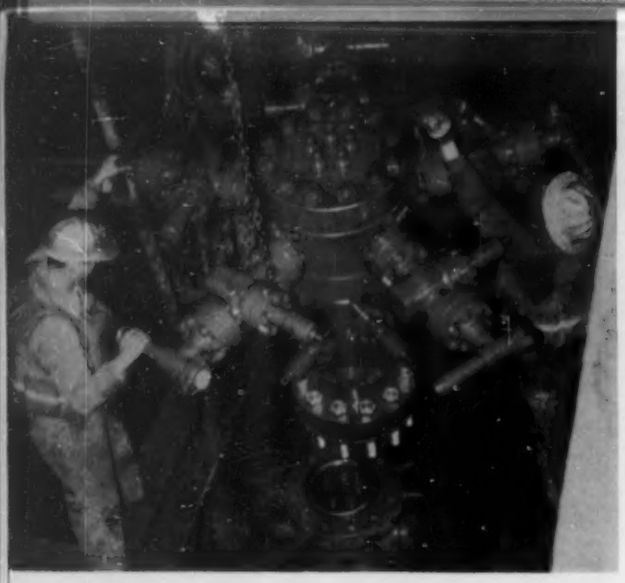

Five Flow Lines
National Cross fitted with Cameron Type "F" Gate Wing Valves
Two Quintuple string solid block Cameron Type "F" Master Valves
National FP-14 Tubing Hanger
Five strings of 2-3/8" Tubing
6100' Tubing per string above last quintuple packer.
Brown Retrievable Type HS-8-5 Hydraulic Set Packer
Zone F
Brown Retrievable Type HS-8-4C Hydraulic Set Packer
Zone E
Brown Retrievable Type HS-8-3C Hydraulic Set Packer
Zone D
Brown Retrievable Type HS-8-2C Hydraulic Set Packer
Zone C
Brown Retrievable Type HS-16-1 Hydraulic Set Packer
Circulating Sleeve
Zone B
Landing Nipple
Brown Retrievable Type HS-16-1 Hydraulic Set Packer
Zone A
7100'

Fig. 1—Schematic of equipment used in Sinclair's quintuple string completion.

A hydraulically operated hoist was used to pick up the tubing strings. A positive-grip lift clamp was used for picking up the tubing. After a joint of tubing is made up in the No. 1 opening of the dual string packer, a joint of tubing is made up in the "CC" Stinger of the No. 2 string. The "CC" Stinger is connected to the dual string packer by threads. With both the No. 1 and No. 2 tubing strings made up in the dual packer, the slip-type elevators are lowered over the two strings of tubing and set up by the driller. The one-piece slips are removed from the multiple tubing string bowl and both tubing strings are lowered in the hole.



Crewmen prepare to land the quintuple Christmas tree assembly.

Auxiliary equipment such as landing nipples, flow couplings, abrasion joints and circulating sleeves were placed in each string and sufficient tubing was run until the spacing was obtained for placing the triple packer in the string. A Shear Pin Safety Joint was placed in the No. 2 String. A CC Safety Joint was placed in the primary (No. 1) tubing string followed by the triple packer. The No. 2 tubing string was connected to the No. 2 string mandrel in the packer by a Brown Adjustable Union. The adjustable union has a 14-in stroke which facilitates spacing out the No. 2 tubing string between the dual and triple packers, and permits a feasible means of connecting the string without rotation.

With the No. 1 String made up in the triple packer, tubing strings Nos. 2 and 3 are made up in the CC Stinger of the triple packer. Now three tubing strings are run simultaneously. To facilitate running of the packers the multiple tubing bowl is a segmented section contained within a housing. With the slip-type elevators set on the three strings, the segmented sections of the multiple tubing bowl are removed and the triple packer is lowered in the hole.

Tubing and auxiliary equipment was placed in the individual tubing strings and lowered in the hole to the point where the quadruple string packer was placed in the string. More equipment was run until the Quintuple String Hydraulic Set Packer was placed in the string. When the quin packer was lowered into the hole, approximately 2,000 ft of tubing, packers, and related equipment had been run in a total elapsed time of 13½ hours.

All packers had now passed through the rotary table and there was no more need for the easily removable segmented sections of the multiple tubing bowl. The segmented sections of the multiple tubing bowl were removed and the one-piece power-actuated multiple slips were placed in the housing. The multiple slip segment is an integral piece and is power-actuated by the driller. This feature permits faster running of the tubing. The driller has readily accessible controls for operating both the elevators and slips.

Installing the stripper type blow-out preventer assures that the well is completely under control at all times while running the five tubing strings. A Brown Oil Tool Stripper-Type Blow-Out Preventer was flanged onto the well. Five individual openings are provided in the stripper rubber. The five tubing strings are inserted through the stripper rubber and the stripper is lowered and locked into a housing. Metal slip segments internally located in the stripper rubber are provided to prevent the tubing from blowing out of the hole, should the well attempt to blow-out while running the five strings. The well pressure will force the segments to grip the tubing and prevent tubing movement. Tubing safety valves were on the floor for stabbing into each tubing string in the event of emergency.

Running tubing. Approximately 30,500 ft of 2⅜-in tubing was run in the hole in 42 hours. Approximately 56 hours' rig time was required since the first packer started in the hole. All five strings consisted of 2⅜-in. OD integral joint 8-Round Thread tubing in the upper portion of the No. 1 String.

Landing tubing. The last joint of tubing in each string was chosen so that all five strings would land at the same point. The National Type FP-14 tubing hanger consisted of a mother hanger with five openings for the individual tubing hangers. The mother hanger was placed on the five strings with the slot opening on the side of hanger facing in the proper direction for landing in the tubing head. The tubing strings had been properly oriented by orienting the No. 1 tubing string when the tubing was first run. With the hook locked, the strings remained in the proper position during running. The individual hangers were made up on the tubing strings and then landed in the mother hanger. The index pin was screwed into the set position in the tubing head and the hanger was thus properly oriented for installing the Christmas tree. Five joints of tubing were made up in the tubing hangers and the entire hanger assembly landed as one unit.

Circulating well and setting packers. With the Christmas tree in place, the next operation was to displace the mud, replace it with a suitable completion fluid and set the packers. None of the packers are set at this time and all tubing strings are landed in normal tension, that is, tension due to their own weight. Reverse circulation down the casing annulus and out the No. 5 tubing string displaced the 11.7-lb/gal mud which was replaced by 11.2-lb/gal weighted water solution containing calcium chloride. When the casing and No. 5 tubing string had been completely displaced and filled with the the completion fluid, a plastic setting ball was pumped down the No. 5 tubing string to set the quintuple string packer. With the ball seated on the seat at the lower end of the mandrel for the No. 5 string in the quintuple packer, the tubing pressure was increased to 5,000 psi to set the packer. To test the packer from the top side, pressure was built up in the casing to 1,800 psi. The pressure was bled off the No. 5 tubing string and the pressure remained constant in the casing indicating that the quintuple string Hydraulic Set Packer was set and holding from the top side.

The pump was connected to the No. 4 tubing string and the mud was displaced from the No. 4 string out and around the quadruple string packer and out the No. 5 tubing string. This displacement procedure pumped the setting ball to the surface where it was retrieved. The quintuple string packer was then tested from beneath the packer. The pressure was bled down to 600 psi in the casing and a pressure of 2,000 psi applied below the packer. The pressure remained constant at 600 psi in the casing, so the quintuple packer was holding satisfactorily from below the packer.

The plastic setting ball was pumped down the No. 4 tubing string and the quadruple string packer was set and holding satisfactorily. The displacing, setting, and testing procedure was continued in a like manner until all multiple string packers had been set.

To set the two single string type HS-16-1 Hydraulic Set Packers, a bronze ball was dropped down the tubing and seated on the shear sleeve below the lower-most single packer. The pressure in the No. 1 tubing string was built up to 4,000 psi. The shear pins sheared and the ball and shear sleeve fell to the bottom of the hole.

The zones were then swabbed in and placed on test.

Cameron Type "F" gate valves, an exclusive design with rotating seats to reduce wear and cut costs, played an important part in the completion. The Type "F" is readily adaptable to construction in special body configurations to meet the requirements for manifording multiple tubing string completion wells on minimum center spacing. It permits the running of larger strings of tubing inside the smallest possible casing (e.g., 3 strings of 2⅜-in. OD tubing inside all weights 7⅝-in. OD or 7-in. OD 26# or lighter casing).

These valves are available on special order in two body styles (master valves and cross-type valves), each in two methods of construction (fabricated block or solid block). The bottom preparation is counterbored to fit the seal needs of Cameron tubing hangers or individual seal subs. They may be provided with plastic injection ports.

END

Designers and engineers work years ahead of actual production. Nothing is left to chance and every detail of construction is checked and rechecked. Designers work directly with decorators and metal craftsmen to select new materials which can aid them in working out advanced designs.

there's more to Cities Service than meets the eye!

More than seven million new cars will roll off the production lines this year. Behind their beauty and performance is a complex network of designers, researchers, test drivers, and testing laboratories where models are checked and rechecked. Most of us fail to realize the enormous combination of people and tasks it takes to produce the "pride of the family."

Likewise, motorists pulling into a Cities Service station in their new, high-powered cars don't realize the vast number of people and jobs it takes to produce gasolene. For instance, Cities Service has a full staff of research and technical experts, searches four continents for oil, maintains giant refineries, research labs, and uses a pipe-line system that can circle the globe... and operates a fleet of swift super-tankers too!

And it takes years-ahead planning also, to meet the demands of the new cars. Cities Service has spent over a billion dollars already in product development and expansion of facilities.

Only in this way can America have what it needs for progress—more jobs and more and better oil products.

CITIES SERVICE

Report for 1959

The British Petroleum Company

Production, sales and earnings of the BP Group were all slightly above the record levels of 1958. The Group's income before taxation was £131 million, less by £7 million than in 1958, despite the increase in sales tonnage—a reflection of the depression in prices caused by the strongly competitive market conditions. Nevertheless, owing to a reduction in the charge for taxation, the Group's net income of £63 million was slightly higher than last year's. A total of £97 million has been retained in the business. Total capital expenditures in 1959 amounted to £141 million.

While 1959 showed an appreciable recovery in the rate of expansion of demand, the industry is likely to continue to experience difficulties due to oversupply. Various factors, including the restriction of imports into the U.S., exports from the Sahara, and the growth of exports from Russia, tend to concentrate these difficulties in the Eastern Hemisphere, where the BP Group has its main interests. In these circumstances it should not be expected that the growth of Middle East production will continue at the same high rate as the last decade.

BP's arrangements with Sinclair Oil Corporation should prove of long-term benefit to both companies. The development of the business of Sinclair and BP Sales, Inc. has been retarded by the restriction on imports into the U.S.A. but the company has secured business with a number of import quota holders. Sinclair and BP Explorations, Inc. investigated production prospects in Colombia and work is continuing. A geological survey also has been completed in British Honduras.

Although an increase in sales is expected during 1960, no material increase in trading margins can be anticipated, though the Group is effecting operational economies. Current difficulties, however, should not obscure the encouraging longer term prospects of the oil industry. Population growth, economic expansion, industrialization, and improvements in living standards—particularly in under-developed countries—will be accompanied by a continuing increase in the demand for energy in which oil has a major role to play. The O.E.E.C. Energy Advisory Commission recently forecast for Western Europe a 1965 demand for oil products equivalent to 200-240 million tons of crude oil, compared with about 157 million tons in 1959. Total free world oil demand is expected to increase 35 per cent by 1965. Granted freedom of international trade, the oil industry should therefore continue to enjoy confidence as a growth industry and the Group is well placed to participate in this growth.

THE BRITISH PETROLEUM COMPANY

BP GROUP INCOME STATEMENT

FOR THE YEAR ENDED 31st DECEMBER

	1959	1958
Sales Proceeds	£860,039,000	£829,294,000
Deduct: Sales Taxes, Customs and Excise Duties, etc.	247,924,000	231,009,000
Net Sales	612,115,000	598,285,000
Dividends and Other Income	15,361,000	17,567,000
	627,476,000	615,852,000
Cost of Oil, Operating, Selling and Administration Expenses	444,232,000	423,424,000
Depreciation and Amounts Written Off	46,554,000	48,533,000
Interest Payable	5,732,000	5,952,000
	496,518,000	477,909,000
Income Before Taxation	130,958,000	137,943,000
Taxation	67,498,000	74,758,000
	63,460,000	63,185,000
Income applicable to Minority Shareholders	102,000	233,000
Net Income	£63,358,000	£62,952,000
Attributable to:		
Consolidated Companies	62,149,000	61,923,000
Non-Consolidated Companies	1,209,000	1,029,000
	£63,358,000	£62,952,000

SALES

While total sales of crude oil and refined products were approximately 65 million tons, an increase of 3 million tons (4 per cent) over 1958, inland product sales rose nearly 10 per cent, thus confirming the trend to cover a greater proportion of product sales through the Group's own marketing organizations.

PRODUCTION

The Group's principal sources of production continue to be Kuwait, Iran, Iraq and Qatar. Nigeria, where crude output more than doubled in 1959, can now be regarded as an oil producing country. The Group is half-owner of the Nigerian producing company. The Group also has production interests in the United Kingdom, Canada, Egypt and in Trinidad, where production again increased.

REFINERIES

The total quantity of crude oil refined for the Group in all refineries was just under 780,000 barrels a day in 1959. Several existing refineries were expanded, one new one was commissioned and two others (one in Montreal) are to be commissioned in 1960. In addition the Group has interests in refineries under active consideration, planned or being built in New Zealand, Turkey, Africa, France and Northern Ireland. The Group's operations in petrochemicals were again increased in 1959. The Sunbury Research Centre was also active in this and other fields.

TANKERS

Because of the world surplus of tanker tonnage, the Group has spread out deliveries of tankers on order. At the end of 1959, the Group's tanker fleet consisted of 144 ships of 2,644,000 dead weight tons—fewer ships but more tonnage than in 1958. In addition, the Group has 2,800,000 dead weight tons on charter, slightly less than in 1958.

DIVIDENDS

The Directors have recommended a final dividend on the ordinary stock of one shilling and six pence per £1 unit of stock, free of United Kingdom income tax, making a total for the year of two shillings and two pence per £1 unit of stock, free of U.K. income tax. The Annual General Meeting will be held in London on May 19, 1960.

LIMITED BP **BRITANNIC HOUSE · FINSBURY CIRCUS**
LONDON · E. C. 2 BP

Petrochemical carbon disulfide from methane

by Peter W. Sherwood*

CARBON DISULFIDE, traditionally produced by the high-temperature reaction of sulfur with charcoal, is drawing in rapidly increasing measure on methane and sulfur as its raw materials.

Most recent additions to petrochemical carbon disulfide capacity are the following four installations, in all of which natural gas and sulfur serve as feedstocks: Stauffer Chemical Co.'s plant now under construction at LeMoyne, Alabama; a 20 million lb/yr plant being built by Snia Viscosa at Varedo, Italy; a unit just announced by Stauffer for construction at Delaware City, Del.; and a 105 million lb/yr plant to be built at Cologne, Germany, by Carbosulf, a joint venture of Glanzstoff Courtaulds and Dr. Jacob, Chemische Fabrik.

This trend toward the more favorable raw materials position of the petrochemical industry, and away from the high investment base of the conventional high-temperature technology, is particularly important in the light of the competitive pressures which plague the carbon disulfide market. The three main outlets for carbon disulfide are production of viscose rayon and cellophane and the manufacture of carbon tetrachloride. During the last few years, all three of these end products have lost substantial parts of their established markets to newer competitive products. In addition, carbon tetrachloride producers are turning in increasing measure away from carbon disulfide and toward direct chlorination of methane.

The results on the overall carbon disulfide market are reflected in the following USA production figures (million lb/year):

1950....426	1956....555
1952....476	1957....528
1954....477	1958....469

The low shown in 1958 is undoubtedly atypical, as it reflects the low production level reported for most major commodities during that year. Beyond that, however, there are specific market pressures which hamper the long-range growth outlook for carbon disulfide.

Despite such unfavorable outlook, production capacity for this commodity is being expanded and research activity is quite strong in the further development of the petrochemical routes to carbon disulfide. Obviously, the individual producer is less concerned with the overall development of the market than he is with his own raw materials position, production economics and with his own share of the market.

The wide-spread adoption during the past twelve years of processes for partial oxidation of hydrogen sulfide recovered from sour gases has made the petroleum industry a net producer of sulfur. Indeed, during 1958, this source accounted for 8% of elemental sulfur output in the United States. Thus, the petroleum industry is basic in both raw materials required for manufacture of carbon disulfide, namely methane and elemental sulfur.

In evaluating manufacture of carbon disulfide as a means to upgrade these basic raw materials, market and technological considerations constitute the key. It will be the purpose of this article to discuss factors involved in those two aspects.

A. Market Considerations. By far the largest single consumers for carbon disulfide are the manufacturers of regenerated cellulose. The two most important products in this field are viscose rayon, which accounts for 60-65% of the U.S. demand for carbon disulfide; and cellophane, which is responsible for 12-15% of total domestic consumption.

Both types of regenerated cellulose are produced by treating cotton linters or wood pulp with sodium hydroxide solution and reacting the resulting alkali cellulose with carbon disulfide. The reaction product is cellulose xanthate which is treated with dilute alkali solution to form a colloidal suspension, or viscose, which is filtered and aged for several days. The end product, regenerated cellulose, is obtained by extruding the viscose solution into an acid (sulfuric acid/sodium sulfate) bath to form cellulose, sodium sulfate and carbon disulfide. In the case of viscose rayon, the extrusion head is a spineret containing several thousand holes as small as .002 inch in diameter,

*Chemical Engineer, White Plains, N. Y.

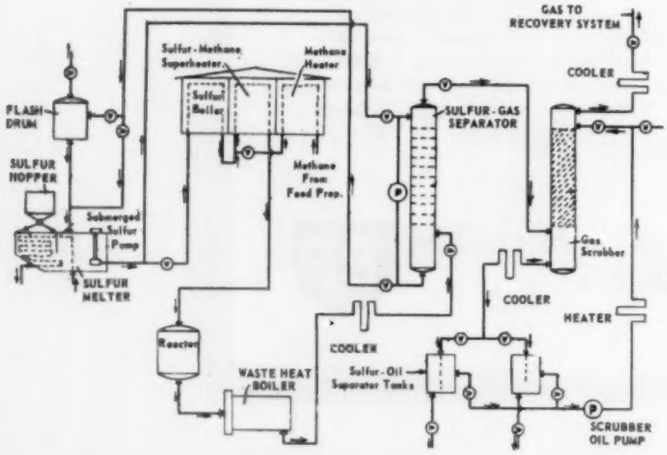


Fig. 1—Process for production of carbon disulfide from methane and sulfur—reaction section.

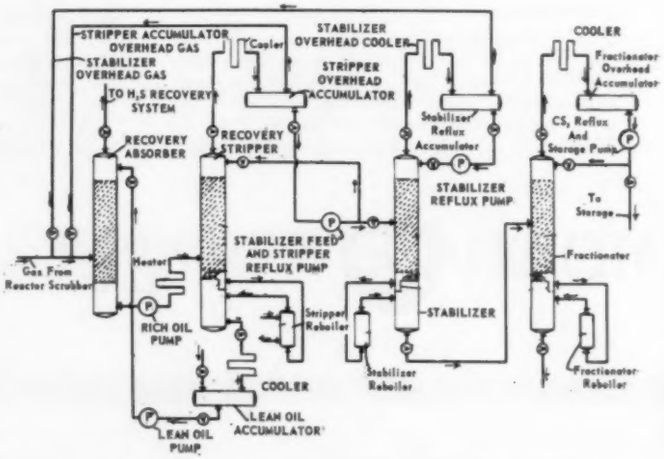


Fig. 2—Process for production of carbon disulfide from methane and sulfur—product purification section.

IN ENGLAND

Dewrance & Co. Ltd., London
Ashcroft Duragauges
Ashcroft Pneumatic Transmitters
Consolidated Safety Relief Valves
Consolidated Safety Valves
Consolidated "Maxiflow" Safety Valves
Consolidated "Electromatic" Relief Valves

IN FRANCE

Sapag, Paris
Consolidated Safety Relief Valves
Hancock Steel Gate and Globe Valves
Hancock Steel "Flocontrol" Valves

Ready to serve you anywhere on the globe

IN CANADA

Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario
Ashcroft Gauges
Consolidated Safety and Safety Relief Valves
Hancock Bronze and Steel Valves
American Bi-Metal Thermometers
American Temperature Regulators

IN BELGIUM

Ateliers Jasper, S.A., Liege
Consolidated Safety Valves

IN ITALY

Societa Carraro & Co., Milan
Consolidated Safety Valves
Hancock Temperature Regulators
Filotecnica Salmoiraghi—SPA, Milan
Ashcroft Duragauges
Ashcroft Pneumatic Transmitters

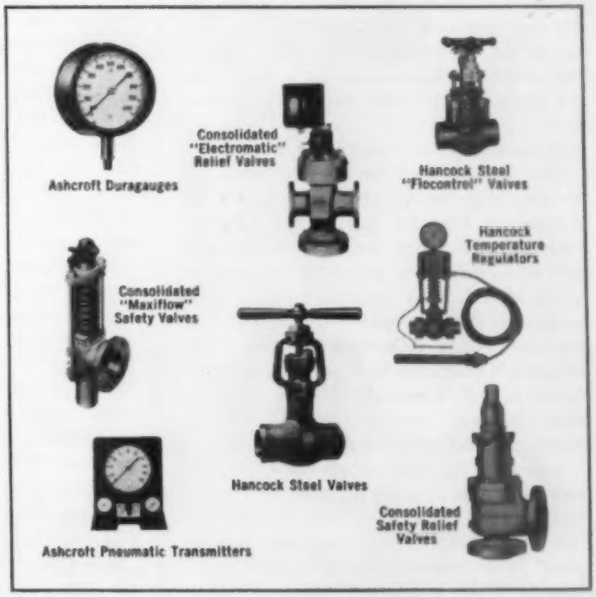
IN WESTERN GERMANY

Deutsche Babcock & Wilcox Dampfkessel-Werke, Oberhausen (Rheinl)
Consolidated Safety Relief Valves
Consolidated Safety Valves
Consolidated "Maxiflow" Safety Valves
Consolidated "Electromatic" Relief Valves

Demand by the petroleum industry for world-wide application of our pressure gauges, industrial instruments and valves is now being met by our licensees in England, France, Belgium, Western Germany, and Italy. Payment in the currencies of those countries.

These licensees are manufacturing our brands of measurement, transmission and protective devices to the same standards of quality and performance that have earned high preference from the petroleum industry in the United States, Canada, and Latin America.

Whether you are planning new facilities or upgrading existing processes, your most exacting requirements in instrumentation and valves will be met by our licensees. They welcome the opportunity to assist you with experienced counsel and specific product information. Or write us direct.



MANNING MAXWELL & MOORE M&M TRADE MARK

MANNING, MAXWELL & MOORE, INC.

All Areas Except Western Hemisphere: Manning, Maxwell & Moore, S. A., Fribourg, Switzerland
Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario
Latin America: Export Division, Chrysler Bldg., New York, N. Y.

so that rayon filaments are formed. In the case of cellophane production, extrusion takes place in sheet form (typical thickness: 3 mil).

In the process, an average of 0.31 lb carbon disulfide is produced per lb of regenerated cellulose produced.

The growth outlook for carbon disulfide in rayon production is not favorable, as competitive synthetic fibers (notably nylon) are making heavy inroads into markets for viscose rayon. Thus, viscose rayon consumption in tire cord, the largest single rayon outlet, has declined from 439.8 million lb in 1953 to 310.5 million lb in 1957. More recently, however, there has been some resurgence in viscose rayon demand for this and other high-tenacity applications due, in part, to a strong promotional campaign but due also to the recent introduction of rayon filaments of improved properties. Overall, the industry anticipates a moderate short-range expansion but a long-range downward trend in the consumption of the various rayon types.

In the cellophane industry, as is the case in rayon manufacture, carbon disulfide is tied to a market which offers little promise of long-term growth. Newer types of polymer (notably polystyrene, polyesters, polyethylene, polyvinylidene chloride and, of late, polypropylene) are crowding cellophane film out of many important applications, a trend which still continues. Notably affected are uses of cellophane in magnetic, electrical and pressure-sensitive tape, in window envelopes and in wrapping applications.

This development is impelled by better properties (e.g., higher tensile strength, greater tear resistance, ease of sealing) of the new polymers and takes place in the face of the relatively low price of cellophane film which is about equal to polyethylene and lower than all other major competitive films.

In the market for cellophane, these competitive inroads have been partly offset by the very large overall growth in the use of transparent film for packaging purposes. Some promise is also seen in the development of superior, and thus more competitive grades of cellophane, notably by coating or combining the film with various synthetic polymers. Today, cellophane of various film thickness is marketed in four major grades: moistureproof, heat-sealing; moistureproof, water-resistant; moistureproof, polymer coated; and polyethylene-cellophane film.

Together, the various grades of regenerated cellulose account for somewhat more than 75% of demand for carbon disulfide. The lion's share of the remainder is consumed in the manufacture of carbon tetrachloride which accounts for some 15-17% of domestic carbon disulfide use.

As a route to carbon tetrachloride, chlorination of carbon disulfide has the virtue of yielding a minimum of by-products. By comparison, the competitive direct chlorination of methane yields carbon tetrachloride along with other chloromethanes and hydrogen chloride. The economics of methane chlorination are therefore tied to the ability to dispose profitably of these co-products. Where by-product HCl has essentially no value, the carbon disulfide route continues to be a competitive method for carbon tetrachloride manufacture.

The trend of recent years has, however, been in the direction of direct chlorination of methane as route to carbon tetrachloride production. Key has been the development of markets for the lower chlorinated methanes, the development of techniques which permit closer control over the ratio of chloromethanes formed and the ability, in many locations, to dispose of by-product HCl (e.g., for production of vinyl chloride, ethyl chloride, or chloroprene or as muriatic acid). At this writing, only two of the ten carbon tetrachloride plants in the USA are based on chlorination of carbon disulfide.

Overall, the market for carbon tetrachloride continues to show a moderate upward trend (average growth rate of about 5-6% per year). Most of the increase is due to rising demand for derivative chlorofluorohydrocarbons (as refrigerants and aerosol propellants). Production of these materials is responsible for 65-70% of the demand for carbon tetrachloride. Expansion in this area more than offsets the decline in carbon tetrachloride's secondary market, as solvent for industrial cleaning and for dry cleaning purposes, a decline which is experienced due to growing adoption of less toxic competitive solvents, notably perchloroethylene and 1, 1, 2-trichloroethylene.

The only other markets taking a significant share of carbon disulfide are rubber accelerators and flotation chemicals. Beyond that, the material finds its way into a number of minor end products, including thiocarbanilide, thiocyanates, and various agricultural chemicals.

B. Technical Aspects. There are two basic approaches to the synthesis of carbon disulfide from methane: (1) direct synthesis, involving the endothermic reaction of methane with sulfur to yield carbon disulfide plus hydrogen sulfide, and (2) indirect synthesis in which carbon monoxide, derived from methane is reacted with sulfur to yield carbon disulfide and carbon dioxide. In addition, a number of combination processes have been proposed, for example the partial oxidation of hydrogen sulfide in the presence of methane and the reaction of methane and hydrogen sulfide in the presence of carbon dioxide.

Commercially significant is the direct synthesis from methane and sulfur:

$$CH_4 + 4S \rightarrow CS_2 + 2\,H_2S \quad \ldots\ldots (1)$$

Co-product hydrogen sulfide is reconverted to elemental sulfur in a separate partial oxidation unit and can thus be recycled to extinction.

The carbon disulfide reaction is carried out in the vapor phase. While non-catalytic operation is possible, catalysts are employed in commercial practice. Numerous catylast combinations have been proposed; performance of some of the more important types will be reported below. Of industrial interest are silica gel-alumina catalysts promoted by oxides or sulfides of vanadium, chromium, and related metals.

The basic flow is simple. Sulfur is vaporized and joined with methane. The combined feedstream is preheated and passed through the catalytic converter. The reactor effluent is cooled to effect condensation of unconverted sulfur. Following separation of sulfur, the gas is cooled further and scrubbed with a gas oil in which carbon disulfide is absorbed. Product is recovered from its solution in gas oil by stripping, followed by distillation of the stripper overhead.

An insight into some of the key details of a typical process for carbon disulfide production from methane is provided by Figs. 1 and 2. This process incorporates certain refinements, such as the use of liquid sulfur as scrubbing medium in the sulfur-gas separator following the reactor and waste heat boiler. Other refinements are concerned with aspects of controlling the temperature of liquid sulfur and of the reactor feed gas. The reason for these and other variants in the reactor and crude carbon disulfide recovery sections of the process design will become apparent from our subsequent discussion.

Design Considerations. Certain key operating problems are fairly specific, though not unique, to the satisfactory operation of a petrochemical carbon disulfide plant. These problems, and methods for their solution, will be the subject of this discussion. The following main considerations are involved:

(1) Reactor Feed: methane purity, sulfur handling and vaporization, reactants' ratio, and feed preheating.

(2) Reactor Section: catalysts and promoters; effect of reaction variables (temperature, pressure, contact time); and temperature control.

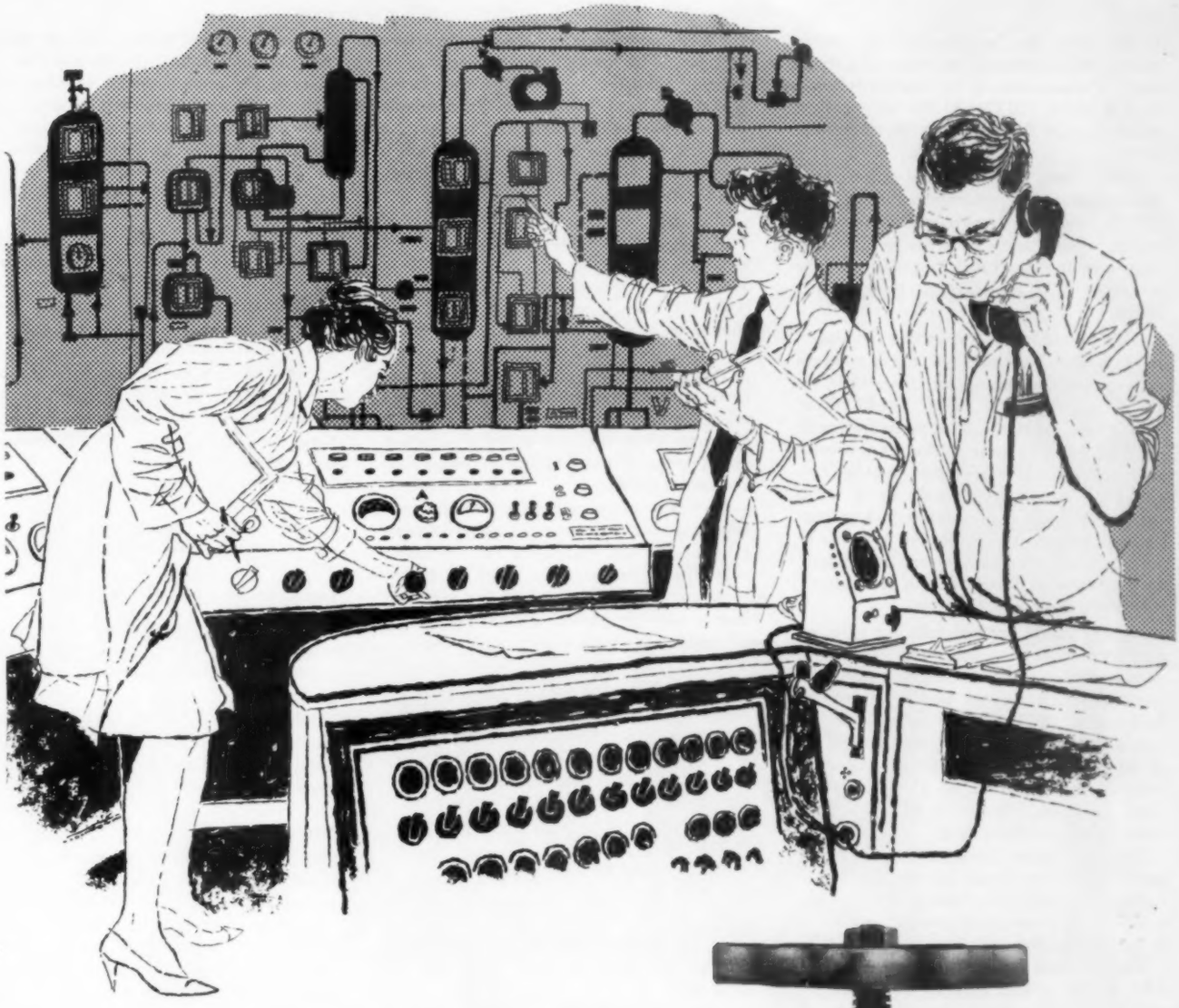
(3) Product Recovery: aftercooling and sulfur separation, crude carbon disulfide recovery, and product refining.

(4) Materials of Construction.

The present discussion will proceed on the basis of this outline.

(1) Reactor Feed. Specifications for the hydrocarbon feedstock call for a methane content of about 98%. Most of the remainder is ethane. Presence of C_3 and hydrocarbons must be well below 1%. This requirement is critical because the higher hydrocarbons enter side reactions under the conditions prevailing in the catalytic converter, with resulting formation of coke-like materials and of high molecular weight, sulfur-containing polymers of tar-like consistency which tend to clog equipment and contaminate both the catalyst and the recycle sulfur.[1]

Sulfur of normal commercial specifications is satisfactory from the point of view of chemical purity. To facilitate melting, it is preferred to receive sulfur in powdered form. The material is stored in hoppers and



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is fed from the hoppers into the sulfur melter which is heated by means of a steam coil. Temperature of the molten sulfur is held at about 130 C. At this temperature, sulfur is quite fluid and can be easily handled.

Sulfur does, however, pose serious handling problems at higher temperatures (150-330 C) where its viscosity reaches very high values. Care must therefore be taken to keep outside this critical temperature range wherever it is necessary to pump liquid sulfur.

This consideration influences the design of the sulfur vaporizer in which it is necessary to raise the temperature from 130 C to the boiling point of sulfur (444.6 C at atmospheric pressure), thus passing through the high-viscosity zone. There are several ways in which this operation may be carried out. One approach calls for a sulfur boiler containing boiling sulfur in a volume which is large in relation to the feed rate of sulfur. The make-up material is pumped to the boiler at 130 C and is fed directly into the boiling pool of sulfur.

An alternative method calls for spraying liquid sulfur droplets into the process hydrocarbon stream at a point just preceding the pipestill which acts as preheater for the feedstream. Still another approach[3] involves the introduction of measured slugs of liquid sulfur into the intake end of a bank of inclined tubes of a slightly oversized vaporizer. Sulfur is joined at this point by the methane feed.

The difficulties involved in handling liquid sulfur are cited[3] as one reason favoring the partial combustion of hydrogen sulfide in the presence of methane as a route to carbon disulfide.

The problem of handling molten sulfur feed to the carbon disulfide converter recurs, in smaller measure, in the recovery of unconverted sulfur leaving the reactor. For this service, the use of hot water has been recommended as cooling medium, keeping the temperature of condensed sulfur at 110-130 C.

Regardless of cooling medium employed, most of the condensed sulfur is carried from the heat exchanger as a fine mist entrained in the reactor effluent gas. This sulfur can be recovered in various ways, including the use of knock-out pots and injection of water.

Probably the simplest and most effective means for recovery of this sulfur involves scrubbing of the carrier gas by means of liquid sulfur. Standard packed towers can be employed in this function. This scrubbing step may, moreover, be made to provide part of the cooling for the reactor product gas. In such an approach, the liquid sulfur medium is circulated through an external heat exchanger. Its temperature throughout the scrubbing system is held within the low-viscosity range indicated above.

At its normal boiling point, sulfur vapor is present as a polyatomic molecule (S_4 or S_2). As the temperature is raised, the sulfur molecule dissociates with the absorption of heat. This endothermic dissociation is promoted further by reducing the partial pressure of the sulfur vapor. Upon mixing sulfur vapor with superheated methane, a drop in temperature would occur which might take the system below the optimum reactor feed temperature.

This difficulty can be avoided by mixing the vaporized sulfur with preheated methane and passing the mixture through a superheater coil en route to the reactor. This approach is indicated in Fig. 1. It should be pointed out that the method is practical only when the hydrocarbon feed is very low in C_3 + hydrocarbons because these heavier materials would enter into extensive condensation and polymerization reactions when they are raised to reaction temperature in the presence of sulfur and absence of catalyst.

The ratio of reactants feed to the converter is not too critical. Stoichiometric ratio is adequate, although a 10-15% excess of sulfur is preferred in order to obtain more complete conversion of the methane. Excess sulfur is recovered from the reactor effluent by the methods indicated above.

(2) Reactor Section. The direct reaction of methane plus sulfur (Equation 1) is only one—though the most predominant—route by which carbon disulfide is formed in the reaction system. Among accompanying reaction, the following are included:

$$CH_4 \rightarrow C + 2H_2 \quad (3)$$
$$C + S_2 \rightarrow CS_2 \quad (4)$$
$$H_2 + S_2 \rightarrow 2H_2S \quad (5)$$
$$H_2S + C \rightarrow CS_2 + 2H_2 \quad (6)$$
$$H_2S \rightarrow H_2 + S \quad (7)$$

It will be noted that all of these main predominant reactions, yield either the desired main product or reconstitutes one of the key raw materials. However, even a desirable side reaction, such as Equation (6) proceeds at relatively low rate at conditions prevailing in the catalytic converter. Catalyst and operating conditions are therefore selected so that Equation (1) will predominate and that the breakdown of methane by carbon- and polymer-forming reactions is held to a minimum.

Two classes of solid catalyst are suitable for the reaction.[4] The first class consists of materials such as silica gel, silica-alumina, bauxite, and activated alumina. These catalysts are most effective in the temperature range 425-700 C. They may be—and generally are—promoted with small amounts of oxides or sulfides of the metals of groups V to VIII of the periodic table (this includes, above all, the oxides or sulfides of iron, vanadium, chromium, molybdenum, and manganese).

The second type of catalyst suitable for the reaction are the metallic sulfides, particularly the sulfides of tungsten, chromium, molybdenum and vanadium. These catalysts are most effective at higher temperatures, notably in the range 700-1,000 C.

Naturally, some individual members of this large group of catalysts are particularly effective for carbon disulfide production, and outstanding performance has been claimed for several specific catalyst formulations. Thus, Folkins[5] reports particularly high activity for 4-5% zirconia on silica gel at 550-600 C. Using magnesia promoted by nickel oxide or cobalt oxide, Guebert[6] reports single-pass conversion as high as 80% at 600-650 C.

Folkins[7] claims that synthetic silica-alumina catalysts containing approximately 2 to 10 wt-% of silica are more active catalysts over the entire temperature range than is activated alumina which is substantially free of alumina. A comparison of different grades of silica-alumina catalysts operated at 600 C, with a space velocity of 389 and at stoichiometric sulfur-methane ratio showed the following key differences:

	SiO_2 wt-%	% conv.
General Chemical 1-3080-19	0.0	81.8
General Chemical 3-2926-23	5.1	88.0
Silica Gel	100.0	90.3
Alorco H-40, R-2200	5.9	93.2
Socony-Vacuum 117,040	Approx. 91.0	80.5

In almost every case, the product contained in excess of 99% carbon disulfide, high-temperature catalysts for carbon dipurity.

Giovannini[8] has investigated the use of high-temperature catalysts for carbon disulfide work. The objective is to promote Equations (3) and (4) to yield the net reaction.

$$CH_4 + 2S \rightarrow CS_2 + 2H_2 \quad (8)$$

which is favored by high temperature. This reaction consumes one-half the sulfur required by the main reaction (1) which proceeds simultaneously and thus offers at least a theoretical advantage, but also practical drawbacks. Evaluation of various metal sulfides as catalysts showed best performance—a yield of 80%—over tungsten-chromium sulfides at 850 C. Interestingly, the use of a catalyst provided no advantage above 1050 C. At this temperature, both non-catalytic and catalytic reaction of sulfur and methane resulted in a carbon disulfide yield of 55%.

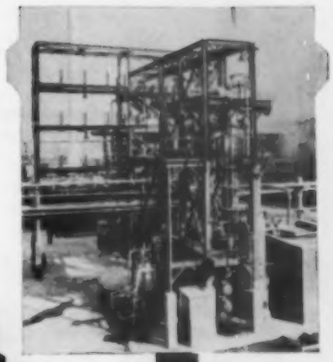
In commercial practice, fixed-bed catalysts are employed. However, the use of fluidized-bed catalysis has been contemplated.[4] In this system, the catalyst itself serves as heat carrier to provide the endothermic reaction heat. Toward this end, fluidized-bed alumina-silica catalyst circulates between the carbon disulfide reaction chamber and a combustion chamber where it is reheated by the partial oxidation of hydrogen sulfide to elemental sulfur. A temperature of about 1000 C is reached in the combustion chamber. In order to avoid a tendency of the catalyst particles to stick together at this temperature, the use of granule sizes between 10 and 40 mesh is called for.

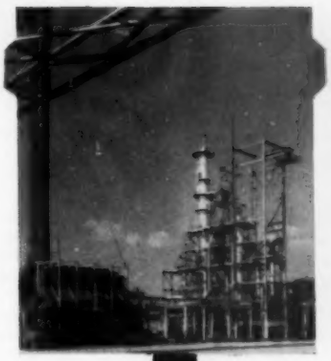
Reaction Variables. Key operating variables in the carbon disulfide converter are temperature, residence time, and pressure. The first two are interrelated in their effect

(Continued on page 68)

catalysts in action

Spence COMOX catalyst is used for desulphurisation in oil refineries throughout the world. COMOX is noted for its long life, high activity, selectivity and robustness under the most severe operating conditions. Spence Product Development Department will gladly provide further information on COMOX and other catalysts which are available in commercial and development quantities.





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Carbon Disulfide from Methane

(*Continued from page 66*)

on per-pass conversion. Both the optimum temperature and residence time are a function of catalyst activity.

The feasible temperature range for catalytic operation is between 450 and 700 C. Below 450 C, reaction rate is too low for practical conversion, while above 675 C, with stoichiometric amount of sulfur present, the reaction system becomes exothermic and difficult to control. More important, sulfur vapor at high temperatures is very corrosive. It is therefore desirable to operate the process at the lowest temperature consistent with good conversion. The normal operating range is between 550 and 650 C.

Within this range, a problem in temperature control occurs in adiabatic reactors due to the simultaneous occurrence of two endothermic reactions. Timmerman[9] calculates that the mixing of sulfur vapor with methane, both of which are preheated to 600 C, is accompanied by a temperature drop of 20-35 C due to the endothermic heat of dissociation of the S_2 molecule which takes place upon reduction in the partial pressure of sulfur. Beyond that, a temperature drop of 75-125 C takes place as a result of heat absorption by the endothermic formation of carbon disulfide from sulfur and methane.

There are several ways in which this problem of temperature drop in adiabatic reactors may be overcome. Obviously, a high enough degree of superheat at the converter entrance will provide the needed thermal requirements in the form of sensible heat. However, this approach raises the objections to operation at very high temperature which we have outlined above.

An alternative approach to temperature control is described by Getz et al.[10] Here, the mixed feed gases are introduced to the reactor at 590-610 C. After the temperature of the system has dropped by about 70-100 C (corresponding to a conversion of 30-40%), the process stream is reheated to 590-610 C and passed to a second reaction zone. This reaction-reheating cycle is repeated one or two more times. In this manner, complete or nearly complete conversion can be achieved in the temperature range 600-530 C. By contrast, single-step conversion would call for initial preheating to at least 675 C.

Optimum space velocity is determined chiefly by catalyst activity and by reaction temperature. In the usual temperature range from 550-650 C, space velocities between 100 and 1,000 hr^{-1} have been reported. Within this range the selection of a lower space velocity results in higher yield but also in a lower production rate per unit of reactor volume. Accordingly, the actual space velocity is selected by economic compromise, usually 6 between 700 and 900 hr^{-1} (calculated at 0 C and 760 mm).

Over a fairly wide range, *pressure* has only a minor effect on the carbon disulfide-producing reaction. The reactor is therefore run at a pressure which exceeds atmospheric only by the pressure drop through the downstream equipment. Higher pressures not only impose additional design requirements on the equipment but would also call for higher temperatures in the hot vapor lines in order to prevent premature condensation of sulfur.

Afterprocessing. The gases leaving the reactor are cooled to approximately 140 C, i.e., a temperature at which liquid sulfur is in mobile condition. Methods for effecting this aftercooling step have been considered above in our discussion of sulfur handling.

Carbon disulfide may be separated from hydrogen sulfide and unreacted hydrocarbons by absorption in oil, such as kerosene or a gas oil fraction. Absorbed carbon disulfide is recovered by stripping from the hydrocarbon medium. Further purification of crude carbon disulfide is effected by fractionation. A typical scheme for this upgrading step is shown in Fig. 2.

Hydrogen sulfide recovered as by-product in the process is passed to a partial oxidation plant where it is converted to elemental sulfur.

Materials of Construction. A serious corrosion problem in the process exists only where sulfur vapor must be handled at high temperature. This situation exists particularly in the vaporizer, the hot gas transfer lines, the converters, and the primary aftercoolers.

Corrosion rate increases very rapidly as the temperature of sulfur vapor is increased above 500 C. Data presented by Timmerman[9] for 25% chromium stainless steel show a corrosion rate of .0125 inches per year at 500 C, .025 IPY at 570 C, .035 IPY at 635 C, and .115 IPY at 700 C.

These data emphasize the need for operation at the lowest feasible temperature. Furthermore, more resistant alloys than simple chrome steels are called for. Thus, Folkins[1] indicates that an alloy containing 16 to 18% chromium, 10 to 14% nickel, 2 to 3% molybdenum, 2% maximum manganese, 0.1% maximum carbon, and the balance iron, is found to be sufficiently resistant to sulfur corrosion to be economical in commercial application in the high-temperature equipment at the conditions outlined above. END

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Gaylord Heads Nomads

NOMADS National Board of Regents has elected its Los Angeles regents to head the organization during 1960. In the center of the picture is Robert P. Gaylord (Wagner-Morehouse, Inc.), chairman; on the left is Earl M. Daniels, (Hydril Co.), secretary; while on the right is Tom R. Ashe, (Globe Oil Tools), treasurer.

Dynamic Decade

The oil industry has entered a "dynamic decade," believe Standard of New Jersey top officials. "Prospects are that demand for all types of energy throughout the free world will continue to increase strongly in the '60's." "Oil and gas combined will share somewhat more than proportionately in filling this demand," they predicted; but the industry is now going through a period of imbalance, "such periods having occurred before, and are likely to be expected." For 1960, SONJ officials look for a slightly better gain in use of oil throughout the free world than the 5.7% increase posted in 1959.

No Import Lift

SONJ's plea that the federal government allow more residual fuel oil (mainly for industrial heating) to enter the country has met with a chilly reception. Import allotments will be boosted, said Interior's Undersecretary Elmer Bennett, but only if the "total situation—as distinct from the position of any single firm—requires it." Unless the present 425,000 b/d industrial fuel-oil import quota for the six months January through June is raised at least 144,000 b/d, a shortage of this fuel will develop, according to SONJ. Gulf Coast refineries raised prices 10¢ to 15¢ per bbl, April 6, because of heavy fuel-oil scarcity in that region. Short supply has been attributed to cutbacks in output because the product has been selling for less than the crude it is made from, combined with bad weather along the Atlantic coast.

Socony Plans for 1960

Capital expenditures of $395 million are programmed for 1960 by Socony Mobil Oil Co., about 10% more than in 1959. Slightly more than half is expected to go into worldwide oil exploration; about 60% of the total outlay is earmarked for the USA and Canada. "Despite excess producibility of the industry," said Socony president Nickerson, the company "would benefit from having larger reserves of crude oil strategically situated to serve our various needs." For the first time, the company registered oil-product output in excess of a million barrels daily during 1959, when its worldwide gross crude production increased 4% to 749,000 b/d and refinery runs advanced 8% to 939,000 b/d. Estimated total crude reserves of the company rose 5% to more than nine billion barrels.

Import Quota Hiked

Interior Dept. Seaton has authorized an increase in the allocations of fuel-oil imports of 12 million barrels, or 132,000 b/d, for the remainder of the first half of 1960.

Markets for Hawaii's Refinery

Standard of California is looking as far away as Guam and French Oceania as possible markets for products from its 32,000 b/d refinery now under construction near Honolulu, scheduled for mid-1962 completion.

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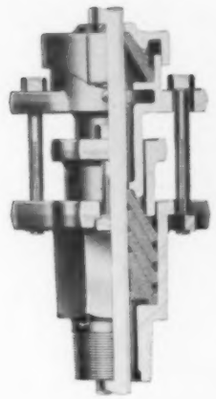

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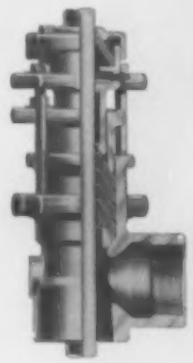

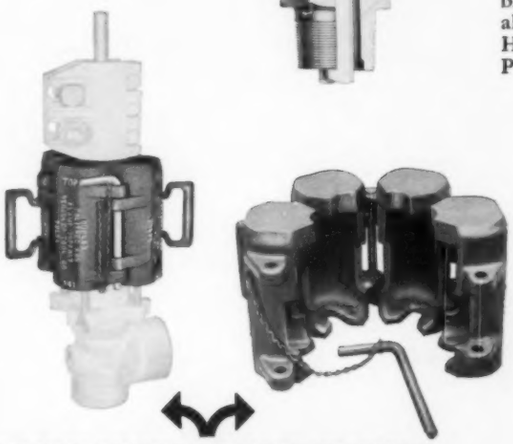

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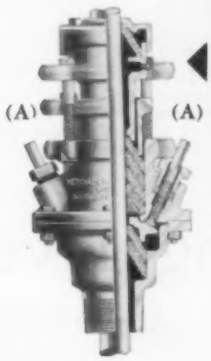

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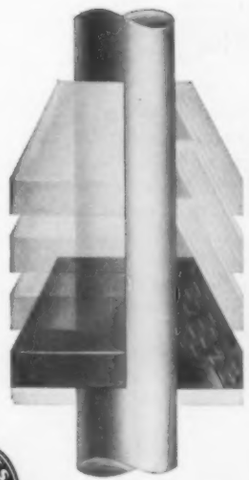

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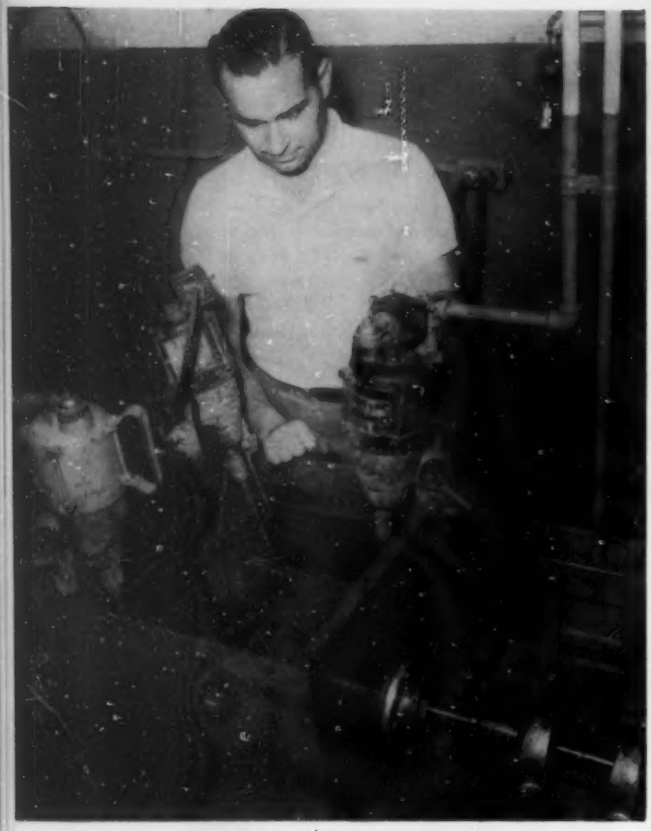
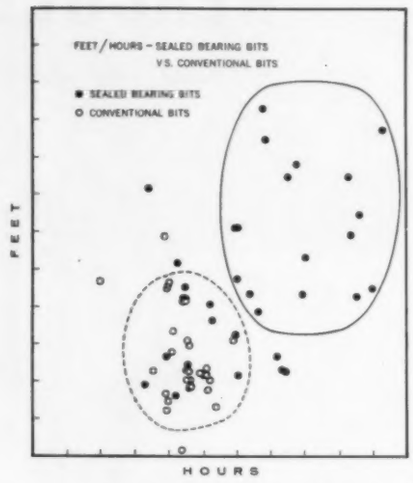


Left: Laboratory apparatus designed by Hughes for testing sealed bearing bits. Simulated operating conditions such as rotating speed, load applied, mud weight and content and temperature can be obtained.

The 8¾-inch bit with self-lubricating sealed bearing. Lubricant reservoir is at top of bit leg.



Scatter chart showing performance of new bits (solid circle) compared with other Hugheset bits (open circle).

New sealed bearing unveiled ~

designed to lengthen bit life

CULMINATING A FIVE-YEAR development period in the research laboratory and in the field, Hughes Tool Co. has begun commercial production of a new bit in which the bearings are lubricated and sealed against intrusion of drilling and formation fluids. Prior to release of the new bit to the drilling industry about 50 prototypes were run in the field as a final test of research laboratory results.

Hughes engineers believe that the sealed bearing bit is a major break-through in drilling tool design because of the added length of effective life given to insert-type bits designed for drilling in chert, lime, dolomite and other highly abrasive and difficult formations.

It was only after the development in 1951 of the insert bit with sintered tungsten carbide buttons to replace chisel teeth that bearings became the limiting factor in bit life in a majority of instances. The crushing and chipping action of the tungsten carbide buttons provided resistance to abrasion not obtained by milled-tooth bits with the result that bearings often failed before cones had become ineffective. Bit life was generally extended about five fold as compared with milled-tooth bits. With abrasive fluids excluded from bearings Hughes engineers now think that bearings will last as long in most cases, as the cones retain a good chipping and grinding configuration.

Engineering design details of the new sealed-bearing bits were not released to oil industry editors who toured the Hughes plant on May 5, but some features were explained by L. L. Payne, the company's chief engineer.

Bit legs of the new bits contain a reservoir which supplies lubricant to the bearing while rotating. Pressure of the fluid column in the borehole is instrumental in moving the lubricant to the bearing surfaces. No details as to design of seals were given except that "O" rings are not employed. Means are provided for equalizing internal and external pressures.

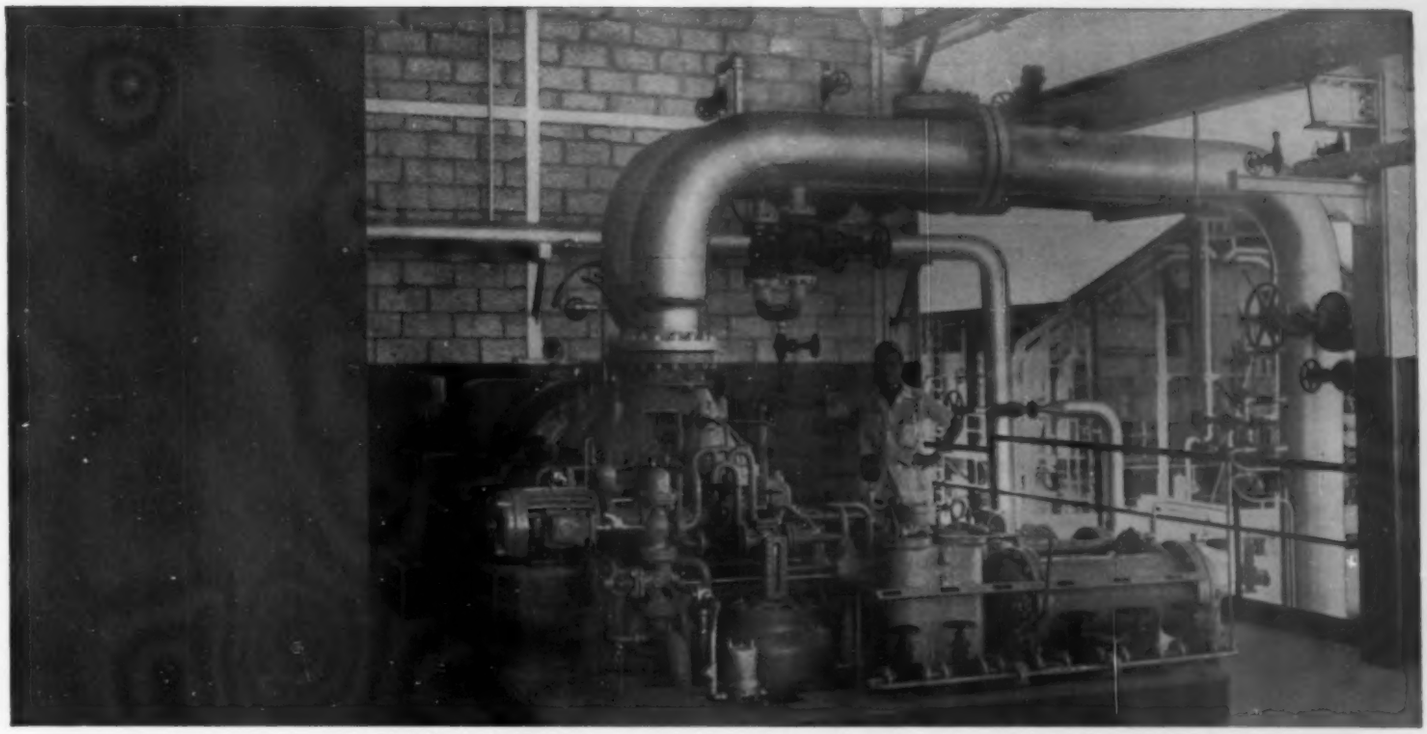
Effectiveness of the seals is indicated by the fact that some bits have shown no loss of lubricant when returned to the factory after completing their useful cutting life. The lubricant is thus not considered a limiting factor in bit life.

Commercial bits now in the field are 3¾-inch but other sizes ranging from 7⅞ to 12¼ will be in production by the end of the year. A 7⅜" bit will be added a little later. Some work also is being done on smaller size bits but there are space problems to be solved. It may be that smaller bearings will provide required service characteristics when lubricated but this remains to be tested in laboratory and field. In present bits the length of roller bearings has been reduced successfully.

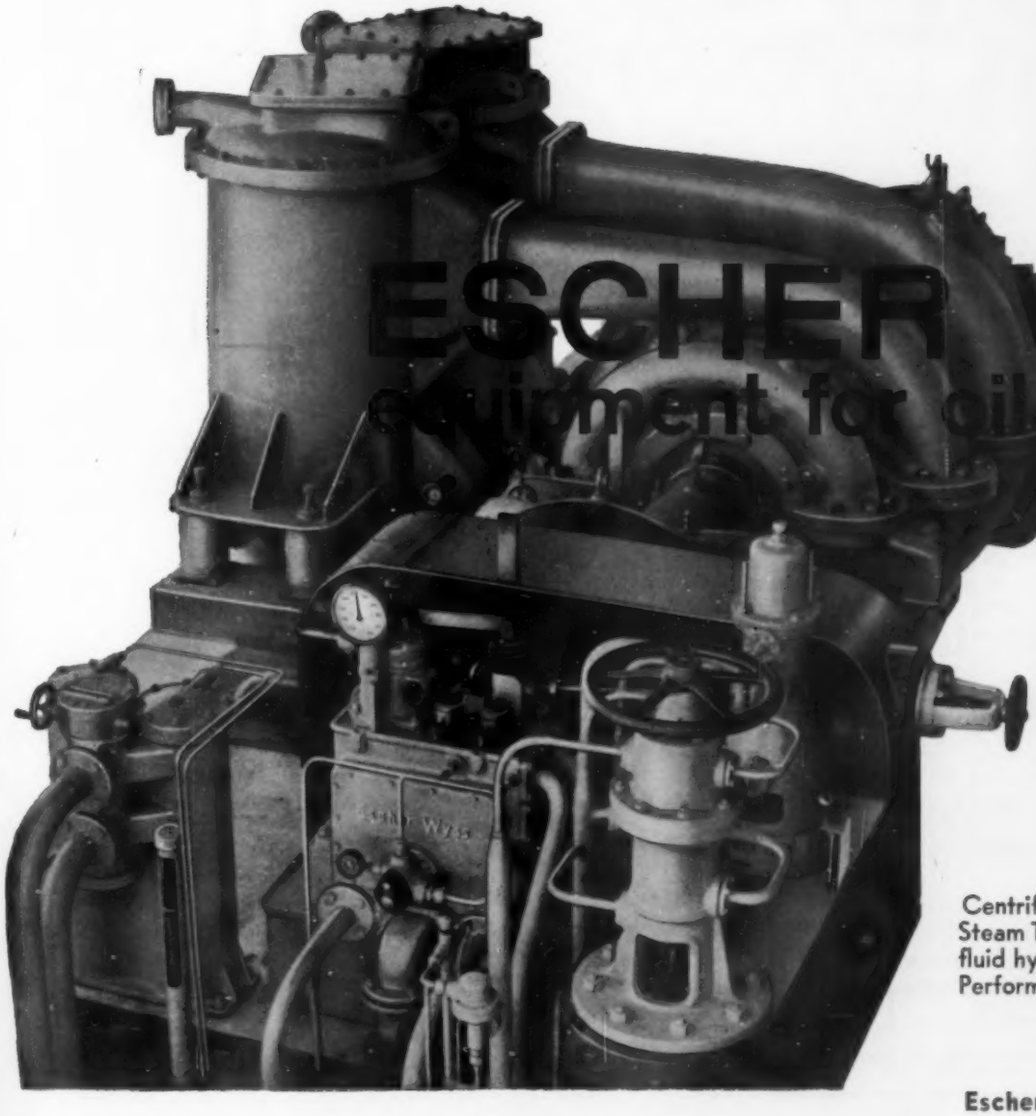
Sealed bearing design has not been applied to tooth-type bits and more development work is to be done in this area. The problem is different from that in insert bits.

Most of the field testing of the sealed-bearing bit has been done in West Texas and New Mexico although runs were not restricted to this area. As indicated in an accompanying chart, tests indicate an average life two to three times as long as non-lubricated bits. Cost of the new bits will be 25 to 35% higher than conventional bits but Hughes engineers think that reduction in number of trips in deep wells and added cutting life will more than offset the higher unit cost.

Visiting editors were taken through Hughes research laboratories and the plant itself which contains 20 acres of manufacturing buildings air conditioned with refrigerating equipment rated at 6,400 tons of ice per day. The editors were shown many of the 1,795 tests to which bits were subjected during the manufacturing process and the new $1 million computing center which keeps a daily inventory on 1,800 types of bits in process and in storage at 140 stations in the USA and elsewhere throughout the oil world. END



Centrifugal Recycle Gas Compressor with sealing oil system, installed in an oil refinery



ESCHER WYSS
equipment for oil refineries

Centrifugal Compressor with Condensing Steam Turbine, supplying combustion air to a fluid hydroformer installed in an oil refinery. Performance: 11,250 cfm, 260 psia, 8150 rpm

Escher Wyss Ltd. Zurich/Switzerland

World Petroleum Statistics

FREE WORLD SUPPLY AND DEMAND, CRUDE AND PRODUCTS, SEPTEMBER 1959

(Thousands of barrels)

Source: USA Bureau of Mines, Division of Petroleum.

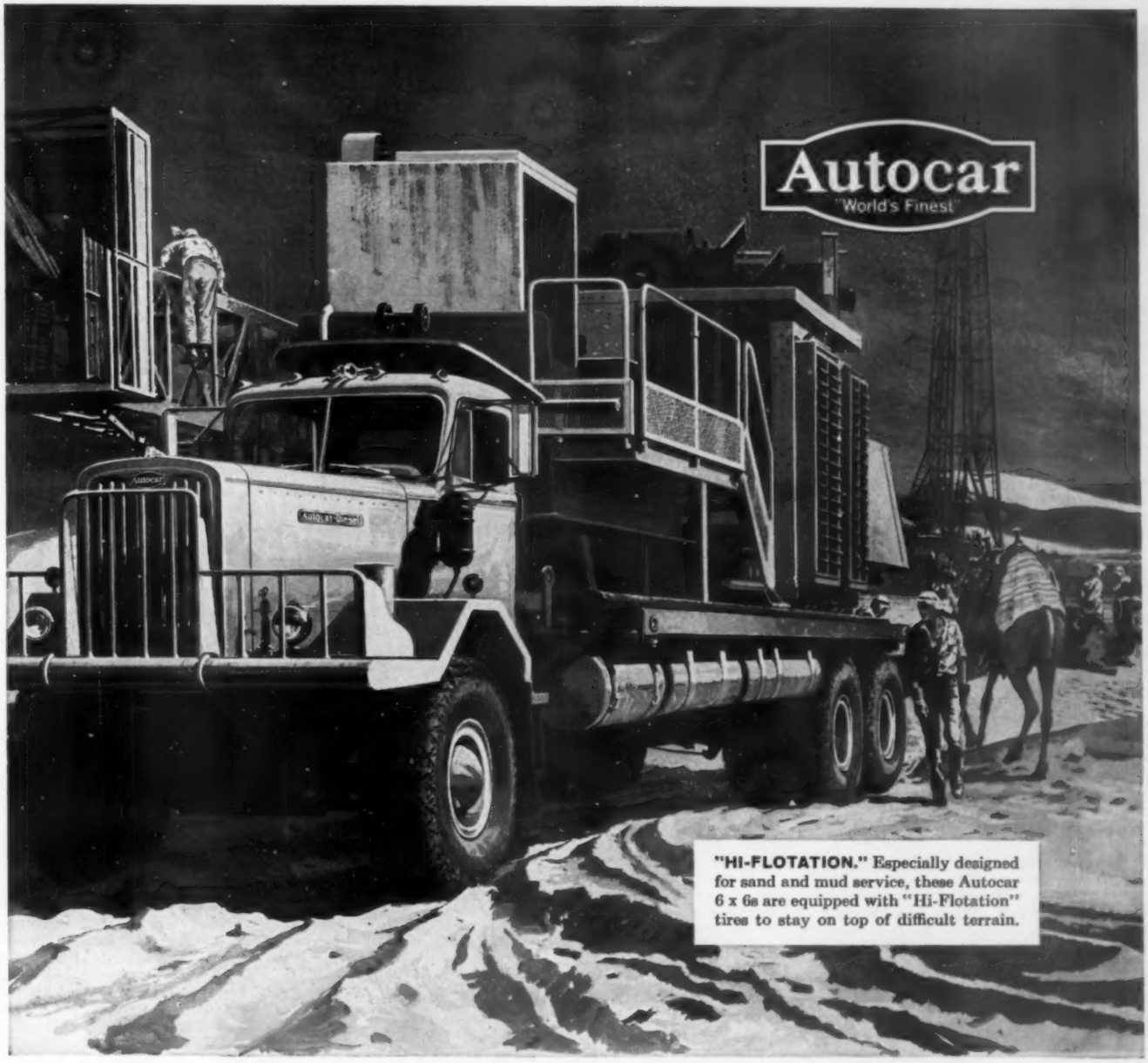
Country	CRUDE PETROLEUM					REFINED PRODUCTS			
	Production	Imports	Exports and reexports	Stock change, other demand, and loss	Total 1/ refinery input / Total 2/ refinery output	Imports	Exports and reexports	Apparent domestic demand (incl. bunkers)	Bunkers-all flags (as reported)
NORTH AMERICA									
Canada	16,462	10,354	3,057	+446	23,580	5,274	40	3/22,904	
Mexico	7,869	-	-	-65	8,495	488	957	8,086	
United States (incl. Alaska)	295,700	29,486	151	-1,291	250,944	21,661	6,569	3/275,891	7,044
Subtotal	230,031	39,840	3,208	-910	283,019	27,423	7,966	306,821	
CENTRAL AMERICA AND CARIBBEAN									
Costa Rica	-	-	-	-	-	E/ 95	-	95	
Cuba	16	1,940	-	+170	1,786	E/366	-	2,152	
Dominican Republic	-	-	-	-	-	E/170	-	170	
El Salvador	-	-	-	-	-	E/144	-	144	
Guatemala	-	-	-	-	-	E/249	-	249	
Haiti	-	-	-	-	-	E/ 72	-	72	
Jamaica	-	-	-	-	-	343	-	343	
Nicaragua	-	-	-	-	-	E/ 90	-	90	
Panama, Canal Zone	-	-	-	-	-	528	156	372	367
Panama, Republic	-	-	-	-	-	E/175	-	175	
Puerto Rico	-	2,280	-	+ 16	2,308	639	1,502	1,525	
Subtotal	16	4,220	-	+186	4,174	2,871	1,658	5,307	
SOUTH AMERICA									
Argentina	3,676	2,718	-	-295	6,689	2,180	E/2,104	3/6,880	72
Bolivia	266	-	76	-11	201	9	1	209	
Brazil	2,169	2,990	1,109	-506	4,556	E/1,095	-	5,651	
Chile	556	206	-	+ 41	734	E/595	-	1,329	
Colombia	4,496	-	2,415	-181	2,317	-	327	3/1,532	
Ecuador	221	-	-	-32	253	124	-	377	
Netherlands Antilles	-	19,076	-	-14	20,215	E/1,467	E/16,548	3/3,134	
Paraguay	-	-	-	-	-	E/ 48	-	48	
Peru	1,416	-	172	-39	1,290	388	249	1,429	12
Trinidad	3,438	3,004	244	+441	5,793	E/ 12	E/4,250	3/1,555	967
Uruguay	-	711	-	-77	788	250	-	1,038	
Venezuela	76,008	-	54,085	-693	22,676	E/ 47	E/18,662	3/4,014	1,295
Subtotal	92,246	28,705	58,041	-1,366	65,512	6,215	42,041	29,196	
WESTERN EUROPE									
Austria	1,379	298	563	-81	1,247	725	83	3/1,619	
Belgium and Luxembourg	-	2,895	-	-1,155	4,080	1,448	1,815	3,713	
Denmark	-	-	-	-26	26	2,823	8	2,841	173
Finland	-	824	-	+224	E/600	321	-	921	
France	1,018	17,509	-	-663	19,190	1,575	4,333	3/14,475	880
Germany, West	3,116	9,968	-	-126	13,210	3,238	1,635	14,813	
Greece	-	560	-	-38	598	191	-	789	
Iceland	-	-	-	-	-	211	-	211	
Ireland	-	1,089	-	+17	1,072	201	-	1,213	
Italy	932	15,866	463	+518	15,904	413	4,108	3/11,843	810
Netherlands	1,011	7,286	-	+654	8,951	3,894	4,894	7,951	531
Norway	-	-	-	-66	66	1,344	-	1,410	
Portugal	-	920	-	+ 47	873	338	12	1,199	
Spain	-	2,045	-	-496	2,598	162	-	2,756	
Sweden	-	1,006	-	-584	E/1,590	4,658	94	6,154	
Switzerland	-	-	-	-	-	1,891	-	1,891	
United Kingdom	53	25,101	-	+1,904	23,250	8,780	4,179	3/24,984	2,563
Yugoslavia	364	E/394	-	+ 15	743	E/ 70	E/ 46	767	
Subtotal	7,893	85,701	1,026	+144	93,934	32,283	21,207	99,550	
MIDDLE EAST									
Aden	-	1,674	-	-565	2,239	868	941	2,166	1,887
Bahrain	1,355	4,683	-	-84	6,062	29	5,261	830	325
Iran	30,312	-	19,766	+ 65	E/10,481	-	6,879	3,602	
Iraq	27,382	-	E/26,356	-	E/1,026	-	-	1,026	
Israel	60	E/640	-	-	E/700	E/859	-	1,559	
Jordan	-	-	-	-	-	E/96	-	96	
Kuwait	38,949	-	36,208	-1,915	4,656	-	2,663	1,993	1,516
Lebanon	-	E/491	-	-	E/491	E/ 22	-	513	
Neutral Zone	3,558	-	E/3,500	-892	E/950	-	E/750	200	
Qatar	5,393	-	E/5,377	-	E/ 16	-	-	16	
Saudi Arabia	31,675	-	26,107	+323	5,245	2	3,434	3/1,697	
Turkey	287	-	-	+11	216	380	-	596	
U.A.R., Syria	-	-	-	-	-	66	-	66	
Subtotal	138,911	7,488	117,314	-3,057	32,082	2,322	19,918	14,360	
AFRICA									
Algeria	639	-	404	+235	-	773	-	3/501	
Angola	31	5	-	-9	45	81	-	126	
Belgian Congo	-	-	-	-	-	275	-	275	
Canary Islands	-	1,763	-	-67	2,024	46	1,431	639	448
Ethiopia	-	-	-	-	-	E/ 57	-	57	
States formerly in French Equatorial Africa	485	-	E/485	-	-	E/ 78	-	78	
French West Africa	-	-	-	-	-	E/339	-	339	
Ghana	-	-	-	-	-	E/262	-	262	
Kenya	-	-	-	-	-	478	93	385	
Liberia	-	-	-	-	-	E/ 32	-	32	
Madagascar	-	-	-	-	-	E/ 54	-	54	
Morocco	62	E/ 60	-	-	122	340	-	3/462	
Nigeria	360	-	E/360	-	-	493	-	493	
Rhodesia & Nyasaland	-	-	-	-	-	E/302	-	302	
Sudan	-	-	-	-	-	127	-	127	
Tanganyika	-	-	-	-	-	59	39	20	
Tunisia	-	-	-	-	-	147	-	3/194	
Uganda	-	-	-	-	-	94	17	77	
Union of South Africa	-	844	-	+38	806	1,676	208	2,274	
U.A.R., Egypt	1,865	E/189	234	-	E/1,800	E/1,030	E/ 12	2,818	
Subtotal	3,442	2,861	1,903	+197	4,797	6,745	1,800	9,535	
SOUTH ASIA, FAR EAST, AND OCEANIA									
Australia	-	6,642	-	+193	6,449	534	582	6,461	607
British Borneo	3,339	-	1,857	-39	E/1,521	E/100	E/1,292	329	
Burma	331	-	-	+ 93	238	E/ 45	-	283	
Ceylon	-	-	-	-	-	1,193	-	1,193	
India	255	E/3,097	-	-	E/3,352	E/1,321	E/ 43	4,630	
Indonesia	11,834	E/910	6,221	-	E/7,012	E/122	E/5,105	2,029	E/413
Japan	245	9,867	-	-1,789	11,841	1,674	116	13,399	
Korea, South	-	-	-	-	-	36	-	3/424	
Malaya and Singapore	-	E/267	E/209	+ 58	-	E/4,059	E/1,458	2,601	
Netherlands New Guinea	134	-	E/134	-	-	-	-	Insig.	
New Caledonia	-	-	-	-	-	E/ 31	-	31	
New Zealand	-	-	-	-	-	743	-	743	
Pakistan	194	-	-	+ 6	188	E/771	-	959	
Philippines	-	898	-	+131	767	E/562	-	1,329	
Taiwan	1	878	-	+310	569	294	-	863	
Thailand	-	-	-	-	-	624	-	624	
Vietnam, South (incl. Cambodia)	-	-	-	-	-	E/272	-	272	
Subtotal	16,333	22,559	8,421	-977	31,937	12,381	8,536	36,170	
WORLD TOTAL EXCLUDING EASTERN EUROPE, U.S.S.R., & MAINLAND CHINA	488,872	191,314	189,513	-5,783	515,455	90,240	102,726	901,019	

E/ Estimate based on latest available data.
1/ Total input includes crude runs to stills plus runs of other unfinished oils, topped crude and natural gas liquids blended.
2/ Total output includes refined product output plus refinery fuel and loss.
3/ Domestic demand as reported, including stock changes.
4/ Apparent domestic demand is heavily influenced by refinery fuel and losses, bunker loadings, and stock changes.

ROTARY RIGS DRILLING

(As of April 1, 1960)

Country	Rigs Drilling
North America	
Canada	101
United States (incl. Alaska)	1,829
	1,930
Latin America	
Argentina	121
Barbados	0
Bolivia	16
Brazil	62
British Honduras	1
Chile	5
Costa Rica	1
Colombia	25
Cuba	0
Ecuador	5
Guatemala	1
Mexico	110
Peru	24
Puerto Rico	1
Trinidad	30
Uruguay	0
Venezuela	53
	455
Total Western Hemisphere	2,385
Africa	
Sahara (OCRS)	46
Angola	5
Ivory Coast	1
Gabon	5
Middle Congo	1
Morocco	4
Madagascar	2
Mozambique	0
Nigeria	6
Tunisia	2
Somaliland Protectorate	0
Somalia	1
Senegal	4
Libya	31
	108
Middle East	
Abu Dhabi	1
Bahrain	0
Egypt	12
Indonesia	17
Iran	13
Iraq	18
Israel	2
Kuwait	5
Lebanon	0
Neutral Zone	5
Qatar	1
Trucial Coast	1
Saudi Arabia	3
Syria	3
Turkey	14
Jordan	1
Muscat & Oman	2
	88
Asia & Australasia	
Australia	7
Burma	6
British Borneo	4
India	9
Formosa	7
Pakistan	9
Japan	12
New Guinea	1
Papua	1
Philippines	2
New Zealand	1
Timor	1
	60
Europe	
Austria	19
British Isles	5
France	42
Germany (West)	130
Italy (Incl. Sicily)	36
Netherlands	4
Portugal	0
Spain	8
Switzerland	0
	344
Total Eastern Hemisphere	600
TOTAL WORLD (Ex USSR etc)	2,985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"World's Finest"
"HI-FLOTATION." Especially designed for sand and mud service, these Autocar 6 x 6s are equipped with "Hi-Flotation" tires to stay on top of difficult terrain.

Oil Exploring in Libya?
Don't take less than Autocar

When in Libya, do as they do in Libya: Depend upon Autocars. They will take you over treacherous soft sand more casually than a camel, hauling heavy equipment and setting up reliable transportation.

When after oil but not in Libya, take the tip, anyway. Only Autocar fully custom-engineers a truck to meet specific operating conditions.

This Autocar is a six-wheel-drive unit with special "Hi-Flotation" tires — each one making a footprint of more than 200 square inches. It hauls draw works, pumps, derricks and power plants deep into the desert. Autocar stands up under the most grueling punishment—yet its life will be long and trouble-free. No wonder oilmen all over the world say, "Send us Autocar, nothing less."

Autocar
"World's Finest"

The White Motor Company
Export Division
Cleveland 1, Ohio, U.S.A.

OIL COMPANY STAFF CHANGES

M. J. Rathbone

E. Holman

L. D. Welch

M. A. Wright

Top Changes at SONJ

Monroe Jackson Rathbone, president of Standard Oil Co. (New Jersey), has been named chief executive officer and chairman of the executive committee. He retains the presidency, a post he has held since 1954. Mr. Rathbone succeeds as chief executive officer Eugene Holman, board chairman, who reaches the company's mandatory retirement age next month. Succeeding Mr. Holman as chairman of the board of directors is Leo D. Welch, an executive vice president, who joined Jersey as treasurer in 1944 after a 25-year career in foreign banking. Mr. Welch will be vice-chairman of the executive committee. M. A. Wright, a director since 1958, was elected an executive vice president and a member of the executive committee.

The company's announcement of the changes in its top positions was accompanied by a statement of regret at the departure of Mr. Holman from its ranks. A leading figure in the national and international oil business for more than a quarter-century, Mr. Holman began his petroleum career as a geologist in 1919. After rising through the ranks to a number of executive posts in Jersey-affiliated companies in this country and overseas, he was named a Jersey director in 1940. Two years later he was elected a vice president and in 1944 was made president. He became board chairman in 1954.

The sixteen year period of Mr. Holman's role as chief executive officer has been one of tremendous expansion for the company. His attention to what he calls the "logistics of oil" has developed great flexibility in crude supplies around the world for the Jersey organization.

A forthright campaigner for world cooperation, industrial peace and responsible private enterprise, Mr. Holman is recognized as a broad-gauged and progressive executive. In 1956 and 1957 he was chairman of the Business Advisory Council for the Department of Commerce and has continued as a member of that organization. He is a member of the board of directors of the Metropolitan Life Insurance Co. and the Chase Manhattan Bank.

Mr. Rathbone, a chemical engineering graduate of Lehigh University, began his career as a draftsman in the Esso refinery at Baton Rouge. In 1936 he became president of Standard Oil Co. of Louisiana, later merged into Esso Standard Oil Co. of which he was also president. After guiding these companies in large programs of wartime supply and postwar expansion, he was elected to the Jersey board in 1949 and was named president five years later. He is chairman of the American Petroleum Institute, president of the board of trustees of Lehigh University, and a director of American Telephone and Telegraph Co. and the Prudential Life Insurance Co.

Mr. Welch began his business career with the National City Bank of New York shortly after his graduation from the University of Rochester in 1919. He began his duties in the bank's branch in Buenos Aires and later became supervisor of its branches in Argentina, Chile and Uruguay. Subsequently he was appointed vice president in charge of First National's operations in the Caribbean area. Coming to Jersey as treasurer in 1944, he was elected a director in 1953, vice president in 1956, and an executive vice president and member of the executive committee in 1958. He is a director of the First National City Bank of New York and of the Commonwealth Fund.

Mr. Wright's first job in the oil business was as an oil field roustabout in his native Oklahoma with a Jersey Standard affiliate in 1933 after he was graduated from Oklahoma State University as a civil engineer. He has been with the Jersey organization ever since. After serving in various engineering positions in Oklahoma and Louisiana, he came to Jersey's New York offices in 1946 and three years later was named deputy coordinator of producing department. In 1951 he was elected executive vice president of International Petroleum Co., Ltd., a Jersey affiliate with operations in Colombia and Peru, and an executive vice president of the Carter Oil Co. in 1952. He was appointed head of all Jersey's production activities two years later and was elected a director in 1958.

In a further organizational change, Jersey Standard has named five new vice presidents and appointed three regional coordinators.

The new vice presidents and their responsibilities are: Marion W. Boyer, who heads a new committee to advise the board on investments and investment policies; Michael L. Haider, Latin America; Peter T. Lamont and W. R. Stott, Europe, the Mediterranean area and West Africa; and Howard Page, the Middle East. The regional coordinators, who will act as executive assistants to the respective regional vice presidents, are: W. A. M. Greeven, Europe, Mediterranean area, and West Africa; M. W. Johnson, Latin America; and S. D. Turner, the Middle East.

JOSEPH L. SEGER, president, Carter division, Humble Oil & Refining Co. to Houston as vice president for public affairs, Humble.

WILLIAM W. BRYAN to headquarters staff of Humble Oil & Refining Co. as vice president for marketing.

ALAN R. MARTIN, Jr. to assistant secretary of Humble Oil & Refining Co. from New York City as assistant secretary of Humble's Esso Standard division.

R. S. BRAMLETT to the newly created position of assistant manager of general office sales in Continental Oil Co.'s marketing department.

C. K. SHEPHERD to general manager of Continental Oil Co.'s central region, with headquarters at Oklahoma City, succeeding **HAL F. NABORS,** who recently transferred to New York as manager of production in the company's foreign department.

C. E. GREENWOOD to administrative assistant to the president of Continental Oil Co. from division geologist for Conoco's Gulf of Mexico division.

F. N. MANN to manager of the Atlantic Refining Co. purchasing department, succeeding **S. PARKS,** who retired in May after nearly forty-five years of service.

CLIFTON C. GARVIN, Jr., to general manager, supply department, Esso Standard Division of Humble Oil & Refining Co., succeeding **DONALD M. COX,** who moved to manager of supply and distribution, a new post.

C. C. Garvin, Jr.

D. M. Cox

Sun Oil Shifts

Sun Oil Co. has promoted three vice presidents to newly-created senior posts and elected three additional vice presidents.

The senior vice presidents are: **JNO G. PEW,** previously vice president in charge of production; **CLARENCE H. THAYER,** previously vice president in charge of manufacturing and of research and engineering, and **WILLARD W. WRIGHT,** previously vice president in charge of marketing.

The new-elected vice presidents are: **THOMAS S. HORROCKS,** vice president in charge of all marketing activities, previously general sales manager; **CHALMER G. KIRKBRIDE,** vice president in charge of research and engineering, previously executive director of those functions; and **KINGSLEY V. SCHROEDER,** vice president in charge of domestic and Canadian production activities, previously director of production.

WILBURN T. ASKEW last February was elected vice president in charge of refineries and will continue in that capacity in the new organization.

JOHN A. MURPHY to executive vice president of Texam Oil Corp., supervising all exploratory activity and other technical operations as well as evaluating new prospects for investment drilling program.

H. C. TEASDEL to chairman of The California Co., mid-continent producing, exploration and marketing subsidiary of Standard Oil Co. of California. Mr. Teasdel will be succeeded as president of Calco by **K. H. SHAFFER,** previously chairman of Standard Oil Co. of Texas, another Standard of California subsidiary.

ROGER M. MATSON to chief geologist of Vickers Petroleum Co., Inc., 42-year-old Kansas, independent, integrated firm.

GUY E. CAMPBELL to acting division manager of Sun Oil Co.'s Mid-Continent Division, to succeed the late George W. Chapman.

DR. PAUL M. PITTS to the newly created position of research manager in the research and development department of The Atlantic Refining Co.

N. L. FALCON, chief geologist of BP Exploration Co. since 1952, has been elected a Fellow of the Royal Society. In 1952 Mr. Falcon received the Murchison Fund Award from the Geological Society of London.

W. H. WOODS to vice president of Texas Gas Exploration Corp., from vice president of Runnels Gas Products Corp., a wholly owned subsidiary of Union Texas Natural Gas Corp.

A. C. MATTEI has resigned as chairman of Honolulu Oil Corp., but will continue to serve as a director. The office of Chairman of the Board will remain vacant for the present time.

WILLIAM B. BILLOCK to director of employee relations for Gulf Oil Corp., following the retirement of **V. H. LUDWIG,** vice president in charge of organization planning and employee relations.

LAWRENCE V. HOWENSTINE to technical sales engineer for the plastics sales branch of Phillips Petroleum Co.'s international department, in New York.

HERMAN G. GUNTER to vice president and general manager of refinery operations of Commonwealth Oil Refining Co., Inc. in Ponce, Puerto Rico.

HERMAN J. BRENNEKE to marketing manager in Central America for Mobil International Oil Co., with responsibility for marketing in Guatemala, San Salvador, Honduras, Nicaragua, Costa Rica, British Honduras and Panama. His headquarters will be in Guatemala City.

WESLEY I. NUNN, advertising manager of Standard Oil Co. (Indiana), retired April 23 at age 65. **ROBERT B. IRONS,** who joined the company 24 years ago and has been assistant advertising manager since 1957, has been promoted to advertising manager. **KARL MUELLER,** with Standard 20 years and district manager at Saginaw, Mich., since 1957, will be advanced to assistant advertising manager.

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E. G. Graeber

Dr. F. H. Blunck

EDWIN G. GRAEBER to technical director in charge of process engineering, Arthur G. McKee & Co.'s refinery division, replacing Luther R. Hill who has resigned. Graeber has been with Air Reduction Co. Inc. and The Lummus Co.

BRUCE K. BROWN to chairman of the board and chief executive officer of Petroleum Chemicals, Inc. **FRANK M. PERRY** succeeds him as president of the company. Mr. Brown has been president of Petroleum Chemicals, Inc. since 1956.

FORD H. BLUNCK has been appointed the new coordinator of foreign operations for Standard Oil Co. (Indiana). Dr. Blunck's coordinating responsibilities will cover all of the foreign operations of Standard and its affiliates, other than those in exploration and production.

FRANK J. KOVAC, associate public relations director of The Standard Oil Co. (Ohio), has resigned to become associate executive director of the Republican National Finance Committee in Washington, D. C. **THOMAS E. MORTON,** who has been manager of employee services becomes assistant director of public relations.

HUGH D. McFADDIN, shareholder representative for Standard Oil Co. (New Jersey) affiliates in Scandinavia, retired May 1 after a 37-year career with the Jersey organization in executive posts in Latin America and Europe. Joining the company in 1923 he subsequently became a marketing assistant in Argentina and by 1925 he had been promoted to assistant manager. In 1928 he was transferred to Poland and in 1937 he became a director of an affiliated company in The Hague. Since then Mr. McFaddin has held executive positions in Chile and England. Since 1945 he has been shareholder representative for various affiliates in Europe.

THOMAS S. LENNOX, manager of Mobil Oil Co.'s Trenton, Mich., refinery since 1956, retired June 1 after 30 years of service. He was succeeded by **KENNETH W. REINHARDT,** manager of Mobil Oil's manufacturing employee relations since 1956. Mr. Reinhardt's successor will be **RUSSELL B. TOMPKINS,** project supervisor in Socony Mobil's employee relations department.

O. P. THOMAS has been elected to the Board of Sinclair Oil Corp. Mr. Thomas, a vice president of the corporation since 1957, was also designated an executive vice president, succeeding **HARRY JEFFRIES,** who has reached retirement age, but continues as a director and chairman of the finance.

O. P. Thomas

A. T. Knight

ALAN T. KNIGHT, formerly executive vice president, has been elected president of Catalytic Construction Co. of Philadelphia, succeeding Mr. T. Ellwood Webster who died on April 1st. Mr. Knight joined Catalytic as a vice president when the company was formed in 1946 and has been executive vice president since 1953. Since joining Catalytic, he has been in charge of construction and maintenance activities, including coordination and direction of all projects and labor relations in the construction field.

PAUL J. PARKER to vice president, international, Phillips Petroleum Co., Bartlesville, Okla.

HARRIS BATEMAN to vice president of Cities Service Oil Co. (Del.) after 33 years with Cities Service in the fields of engineering and purchasing, most recently manager of engineering and purchasing and coordinator between Bartlesville and the Chicago marketing division.

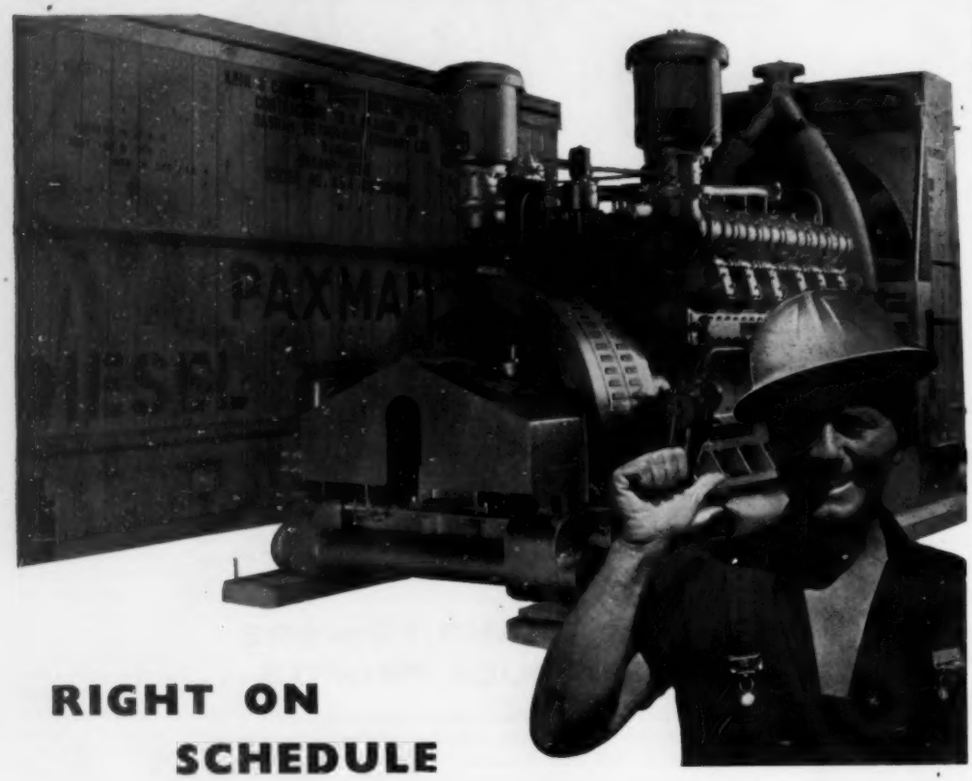
D. R. JOHNSON has been elected vice president of Continental Oil Co. He is general manager of Continental's manufacturing department.

ALEXANDER E. WALKER

Alexander E. Walker, retired chairman of The National Supply Co., died in Pittsburgh, April 19, following an operation. He was 72 years old. Mr. Walker had a total of 44 years service in the steel industry. He joined National Supply, manufacturer and distributor of pipe, oil field machinery, and equipment, in 1939. He was elected president in 1940 and chairman of the board in 1943. He retired as chairman on May 7, 1958.

NEW PUBLICATIONS

Plastics for Corrosion-Resistant Applications, by Seymour and Steiner. This book supplies engineers with the background information necessary in selecting the proper plastic for construction in corrosive atmospheres. It describes the relationship between the chemical and physical properties and the molecular structure of plastic materials. Then follows information on the use of plastics as protective coatings, organic linings, chemical resistant mortar cements, casting resins, plastic foams, impregnants, industrial adhesives and reinforced materials. Other sections describe plastic pipe, ductwork, valves and fittings, and the use of plastics for corrosion-resistant floors, sumps, and processing vessels. Wherever possible, plastics available for a specific application are compared in tabular form for quick, easy selection of the most suitable material. $7.50. Published by Rheinhold Publishing Co., 430 Park Ave., N. Y., N. Y.



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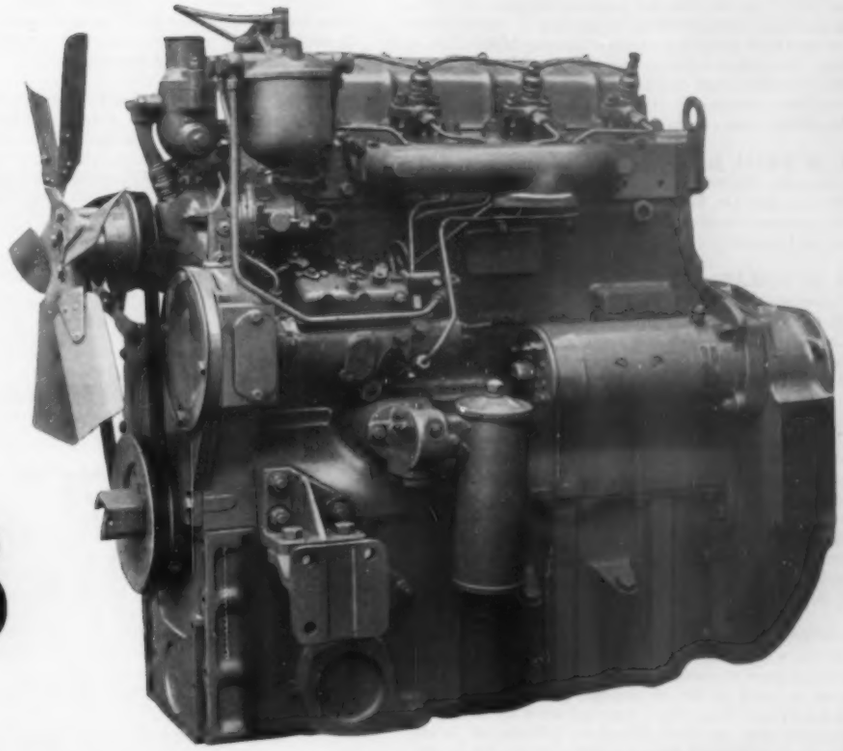

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						1000	1200	1500	1800	2000	2400	3000	3600
Four 99(1)	4	3	3½	99	A	10.5	13.5	18	22	24.5	29	34	—
					B	12	15	20	24.5	27	32	38	—
					C	12	15.5	20.5	25	27	33	39	43
P3/144(1)	3	3½	5	144	A	16.5	20.5	25.5	30	33	—	—	—
					B	18.5	22.5	28	33	36	—	—	—
					C	18.5	23	29	34	37	42	—	—
Four 203(1)	4	3.6	5	203	A	25	30	38	44	47	—	—	—
					B	27.5	33	41	48	52	—	—	—
					C	28	34	43	50	54	60	—	—
Four 270(1)	4	4½	4½	270	A	33	39	47	53	57	—	—	—
					B	36	43	52	58	62	—	—	—
P6(1)	6	3½	5	288	A	34	41	51	60	65	—	—	—
					B	37	45	56	66	72	—	—	—
					C	38	46	58	69	75	83	—	—
R6(1)	6	4	4½	340	A	38	46	58	67	69	—	—	—
					B	41	51	64	74	76	—	—	—
					C	44	54	68	81	89	102	—	—
S6(1)	6	4½	5	450	A	49	62	80	96	105	—	—	—
					B	54	68	88	106	115	—	—	—
					C	56	70	90	108	119	—	—	—

REMARKS

A. Denotes continuous rating to BS 649: 1958 conditions (85°F. and 29·5 hg). For every 10° above 85°F. this rating should be reduced by 2% and for every 1000 ft. above 500 ft. altitude the rating should be reduced by 3½%.
B. Denotes one hour rating to BS 649: 1958 conditions. See notes above re de-rating.
C. Denotes intermittent industrial rating to 60°F. and 30 ins. hg conditions. Similar de-ratings should be made for temperature and altitude conditions.

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R. L. MINCKLER has retired as senior vice president of Mobil Oil Co. He was president of General Petroleum Corp. from 1948 until January 1, when it was merged with other operations of Socony Mobil Oil Co. into one nation-wide operating firm, Mobil Oil Co. Mr. Minckler had declined a high executive position with the company in New York because of his many important community activities in the West.

L. M. REAM, Jr. has been appointed manager of the economics department of The Atlantic Refining Co. He succeeds **Dr. D. C. HAMILTON,** who is leaving the company to accept a position on the teaching staff at the University of Chicago.

R. L. SIELAFF has been named vice president of Tennessee Gas and Oil Co. Mr. Sielaff will be assigned to the company's Canadian division, with offices in Calgary, Alberta, and will serve also as division general manager. He has been general manager of the Rocky Mountain division of the company in Denver.

LAWRENCE A. KIMPTON has joined Standard Oil Co. (Indiana) and will undertake special assignments. He resigned in March after nine years as chancellor of the University of Chicago. He has been a member of Standard Oil's board for two years and is a nominee for reelection at the annual meeting of stockholders May 5. In his assignment he will travel in the United States and abroad to study the company's widespread facilities and operations. He will report to Mr. John E. Swearingen, president.

GEORGE F. BARNWELL, head of Standard-Vacuum Oil Co.'s exploration activities since 1949, has retired and has been succeeded by **J. W. GWINN.** Mr. Gwinn went to work in the oil industry in 1937 with Esso in Louisiana. Two years later he went to Iraq as a geologist and in 1939 joined an affiliate of Jersey Standard in Central America. His service with Standard-Vacuum started in 1947 when he was appointed chief geologist of the company's producing and refining affiliate in Indonesia. Mr. Gwinn was exploration manager there when the call came in 1954 to join the headquarters staff. He became assistant manager two years later.

Mr. Barnwell served as a field geologist in the United States, Sumatra, Java and New Zealand during his 35-year oil career. In his work at The Hague as a technical advisor for a joint exploration venture in New Guinea, and later as an administrator at Stanvac's headquarters, he traveled widely through other parts of the Far East, Africa and Australasia.

HAROLD S. SKINNER has been promoted to manager of public affairs and public relations of Continental Oil Co. In his new position, he will also become a member of the company's management executive committee. **EMERSON G. SMITH,** who is currently director of public information, will continue in that position. **JOHN POST,** manager of industrial relations, was promoted to the newly created position of director of industrial and personnel relations. In his new position, he will serve as special advisor to the president on industrial and personnel relations.

JAMES M. MacNICOL has been named manager of the Saskatchewan division of the Canadian Petroleum Association, headquartered in Regina. He succeeds G. B. (Bert) McGillivray, recently appointed manager of the Association's British Columbia division. The appointment takes effect on June 1.

W. R. STOTT and **HERBERT WILLETTS,** New York oil company executives, have been elected to the board of directors of the American Petroleum Institute. The board also elected **MORGAN J. DAVIS,** president of Humble Oil & Refining Co., Houston, to its executive committee. Mr. Davis has been a board member since 1957. Mr. Stott, a vice president of Standard Oil Co. (New Jersey) replaces Eugene Holman on the board. Mr. Willetts, president of Mobil Oil Co. and executive vice president of Socony Mobil Oil Co., Inc., replaces R. L. Minckler, senior vice president of Mobil Oil Co., Los Angeles.

Enjay Merged into Humble

The Enjay Co. Inc., petrochemicals firm, became the Enjay Chemical Co., a division of Humble Oil & Refining Co., on May 31. Enjay Chemical Co. will be directly responsible for both the marketing and the coordination of the Humble Co.'s chemical products activities throughout the United States. In addition, Enjay will sell chemicals to Esso Export Corp., for distribution in foreign markets.

Knowles Gets Tipro Award

Authoress Ruth Sheldon Knowles, an independent oil operator herself, has been honored with a special "Press Recognition Award," presented by the Texas Independent Producers and Royalty Owners Association at its 14th Annual Meeting in Tyler, Texas. Mrs. Knowles' recently published book, "The Greatest Gambler," chronicles the rags to riches stories of some of oil's greatest wildcatters. Across the base of the award is an inscription, reading:

"In appreciation to Ruth Sheldon Knowles who has, through her colorful and historically accurate book, 'The Greatest Gambler,' combined a rare creative talent with practical first-hand experience as an oil independent to bring a new realism to an era of public affairs that has long suffered from popular misconceptions. Significantly, her best-selling chronicle of America's wild-catters has not only been praised by oil producers large and small, but readers with no previous understanding of the factual story of petroleum have been given a new and enlightened perspective from which to view an industry which personifies the highest attributes of American free enterprise."

The award was presented by Neville Penrose, chairman of TIPRO's public relations committee.

Sun to Expand Petrochemicals

Sun Oil Co. is planning further expansion in petrochemicals in a number of lines, according to Joseph N. Pew, Jr., chairman. Robert G. Dunlop, president, said it is "somewhat undecided" at the moment whether new petrochemical products will be manufactured by Sun on its own, or in affiliation with other companies along lines of its partnerships with Olin Mathieson Chemical Corp. and American Viscose Corp.

Shale Project Closed

Union Oil Co. of California has ended its three-year Colorado shale-oil project. Though the research plant demonstrated the efficiency of the retorting process by extracting as much as 26 gal of oil from a ton of shale, "the present depressed price of crude oil and the tax picture are such as to make the process uneconomic at this time," said the company.

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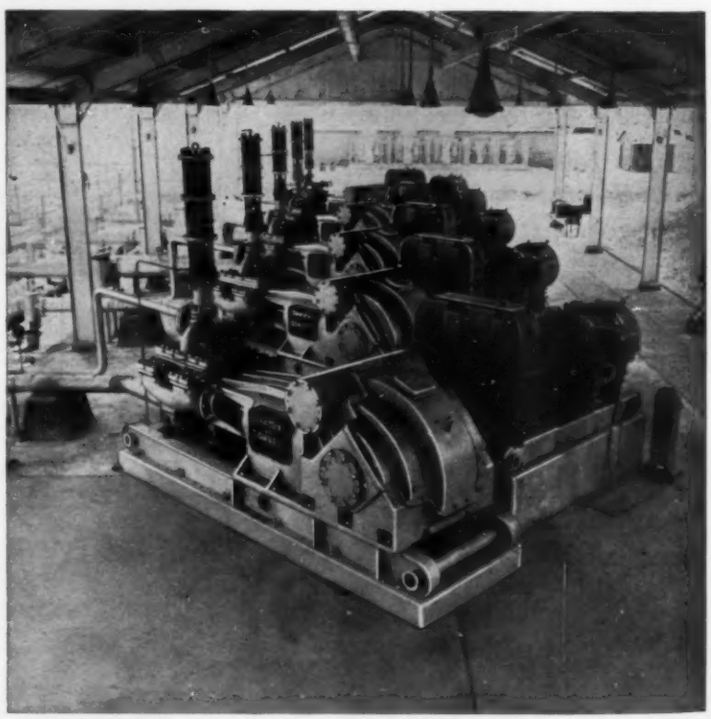
Illustrated is a series of pumps supplied to the British Petroleum Company's Oil Refinery at Aden for pumping diesel and fuel oils from the refinery to the B. P. International Oil Bunkering installation.



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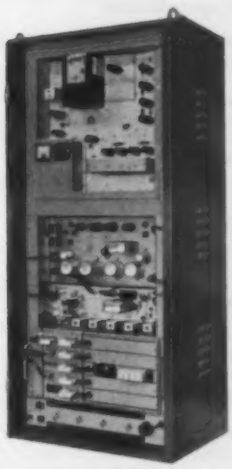

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INTERNATIONAL NEWS AND NOTES

More Drilling in Papua

Australasian Petroleum Co. Pty. Ltd., of which BP Exploration Co. is major partner, will drill a new Papuan test some 15 miles northwest of Barikewa. The wildcat will be known as Iehi No. 1. Two of the partners in Australasian Petroleum Co., BP Exploration Co. and Oil Search Ltd., are each subscribing $2,240,000 to finance the drilling of the Iehi No. 1 well. The third partner in APC—Vacuum Oil Pty. Ltd.—is not participating in the Iehi venture.

Africa-Sicily Gas Lines

GOTA (Gasdotti, Oleodotti Transcontinentali Afro-Europei SpA) has been formed in Rome to study submarine pipeline projects, particularly from the North African coast to Europe. President of the company is Dazio Gilardoni.

At the same time, an Italian industrial group has formed in Sicily a firm named SO.SIM (Societa Siciliana Metanodotti), with a capital of 60 million lire, for the linking of Sicily by gas line with Cape Bon in Tunisia. Included in the group are Sincat (Edison), Akragas (Montecatini), Cementeria Portland and Cementerie Siciliane (Italian cement companies), Cementerie di Augusta (Marchino-Fiat group), Termoelettrica Siciliana and Tifeo (Sicilian General Electric), and ABCD (BPD group).

Planned by Professor Silva of Rome, the company envisions a submarine gas line crossing the Sicily Channel from Cape Bon in Tunisia to Mazara del Vallo, near Trapany in Sicily. The projected line would carry 1.5 billion cubic meters of Saharan natural gas from the Hassi R'Mel field. The line's maximum subsea depth would be 400 meters, and minimum 100 meters.

India's Oil Expenditures

Proposed allocation for oil exploration in the public sector during India's Third Five-Year Plan is Rs. 115 crores. Though nearly four times the resources available for this purpose during the second plan, this sum will suffice only for the government's operations at Cambay and Sibsagar. Official estimate is that by the end of the third plan Cambay will have produced 900,000 tons of crude annually, and at Sibsagar 800,000. The government will have to keep these factors in mind in determining whether to issue oil permits to private companies, many of which have indicated interest in exploration.

New International Company

Mr. Benjamin Tyran has announced organization of "International Petroleum Supply Co.," which will engage world-wide in the purchase and sale of crude oil and refined petroleum products and related activities. Headquarters are in the Raymond-Commerce Building, 1180 Raymond Blvd., Newark 2, New Jersey. Mr. Tyran resigned in February, 1960, from the position of general sales manager of American Independent Oil Co. where he was in charge of the domestic and international sales activities. While with Aminoil, he served also as a director of Iricon Agency, London, and of the Frisia Refining Co., Emden, Germany.

Australian Terminal

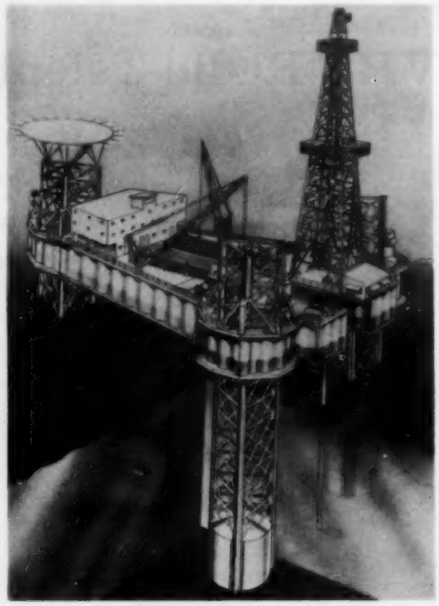
A new $500,000 13-acre oil terminal to be built by Vacuum Oil Co. at the port of Bandaberg, Queensland, near the head of the Burnett River, will handle a full line of oil products. The port can handle 15,000-ton tankers without deepening. Government negotiations are progressing with Caltex for another terminal at Urangan near Maryborough.

New Libyan Discovery

Mobil International Oil Co.'s affiliate in Libya, North Africa, made its second oil discovery in eastern Libya during April. A wildcat well 360 miles southeast of Tripoli flowed 43-gravity oil at the rate of 1,500 b/d during a production test. Known as Hofra No. 2, the discovery well is located on a 4,700,000-acre oil concession area in the Sirte basin. The producing zone in the well is at a depth of approximately 3,030 ft. The well is about 80 miles from the coast. Mobil International's first oil discovery in Libya was Amal 1, completed in November 1959. Hofra 2 is the twelfth well Mobil has drilled in Libya.

Italy's Offshore Platforms

The Italian government plans to step up its offshore oil drilling program with a new $1 million mobile drilling platform to be built in Italy, for 1961 completion, with components and technical guidance furnished by R. G. LeTourneau Inc., Longview, Texas. The giant three-legged platform will be assembled by Nuovo Pignone, an ENI affiliate, at Massa on the north coast of Tuscany, and will be the second mobile platform operated by ENI. After completion, this unit, largest LeTourneau type platform ever built, will be turned over to SAIPEM, another ENI affiliate, for operation. Ultimate destination of the platform has not been announced; however, the ENI group now holds concessions in the Mediterranean, the Adriatic, and the Persian Gulf.



Engineering illustration of a mobile drilling platform to be built in Italy with key components and technical guidance of R. G. LeTourneau Inc.

Socony To Expand

Socony Mobil Oil Co. has budgeted its capital and exploration expenditures for 1960 at $395 million, about 10% more than spent during 1959. The company will expand its exploration and development drilling programs in the Gulf of Mexico and North Africa, which it considers "very promising" production areas. In Libya, where Socony has made one discovery, the company plans 12 wildcats and eight development wells during 1960. Elsewhere in North Africa, it is acquiring a quarter-interest in eight million acres in Algeria (between Hassi Messaoud and Edjele) plus a half million acres in Tunisia. The company also is determined to carve out an important place in the petrochemical industry, according to Albert L. Nickerson, Socony president.

Soviet Oil for Cuban Sugar

Under a pact for exchanging Cuban sugar for Russian oil, the Cuban government's National Petroleum Inst. will distribute Soviet oil in a new island-wide chain of service stations, including confiscated plus independent stations. Supplies will come from two confiscated Cuban oil refineries—with a new terminal being readied to receive the Soviet oil. Oil men in Havana have questioned whether the Cuban refineries can process Soviet crude without modifications.

Gas Shows in Burma

The Burma Oil Co. (1954) Ltd. has announced encouraging gas production from its test well at Payagon in the Delta area. Additional testing over a period of time, and possibly further drilling, will be required before the well's commercial possibilities can be determined. So far no oil has been discovered in this well.

Finland Imports from USSR

Crude-oil imports into Finland during 1959 totaled 1,089,951 metric tons (21,800 b/d)—the bulk of it, or 863,710 tons from the Soviet Union. Iran supplied 209,684, and Venezuela 16,557 tons.

Angola Imports Crude

Crude production in Angola came to 50,553 metric tons (about 953 b/d) during 1959. Some of the 67,545 tons of crude processed was imported. The Petrangol refinery used imported crude for the first time during the 4th quarter of 1959.

Mobil out of Portugal

Mobil International has decided to quit in Portugal, after 17 unsuccessful wells between mid-1955 and 1959. Mobil has been associated with Cia. des Petroleos de Portugal, the government company which, along with the Axel Johnson interests of Sweden, holds a countrywide exploration concession. Mobil's well depths ranged from 1,476 ft to 11,847 ft.

Egypt Plans Output

An Egyptian government official has estimated Egypt's crude output during the Second Five-Year Plan (in millions of metric tons) as follows: 1962—5.1 (about 102,000 b/d); 1963—6.9; 1964—7.86; 1965—8.52. For 1962 through 1964, surplus for export is estimated at 400,000 tons per year; for 1965, about two million tons. Refinery capacity in the Egyptian region is to be raised to 6.5 million tons (about 130,000 b/d) in 1963 from the current 3.5 million.

701,000 B/D for Defense

The U. S. Department of Defense now expects to buy an average of 701,000 b/d of petroleum products in the fiscal year that opens next July 1. This is estimated in a statement published by the Office of Oil and Gas of the U. S. Department of the Interior.

A large part of the products are being bought overseas, but the statement makes no specific estimate of the quantities being bought at home and overseas. But in the fourth quarter of 1959, the department bought about one third of its products overseas. Overseas purchases came to 233,000 b/d out of total procurement of 693,000 b/d.

The department relied upon overseas sources for more than half the JP-5 jet fuel, diesel fuel, Navy special fuel oil and motor gasoline; but the U. S. was the chief supplier of aviation gasoline, other jet fuel, distillate fuel and residual fuel oil, the statement explains.

Nearly half of the fiscal 1961 buying will be made up of jet fuel, other than JP-5, which is estimated at 340,000 b/d. Another 14,000 b/d of JP-5 will be bought. Next largest in volume is Navy special fuel oil at 97,000 b/d, followed by aviation gasoline, diesel oil, motor gasoline, other residual oil, in that order.

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BRANCHES AND AGENTS THROUGHOUT THE WORLD

Yugoslavia Imports Crude

During 1959 Yugoslavia imported 619,380 metric tons (about 12,388 b/d) of crude. This included 411,566 from the USSR, 169,138 from Iraq, 20,722 from Egypt, 11,778 from Bulgaria, and 6,175 tons from Venezuela.

50-50 French Search

The French government-controlled Cie. d'Exploration Petroliere has joined a 50-50 partnership with Esso Rep for exploration on CEP's 681-square-mile Carmague permit in southern France, of which CEP will be operator. The partners already hold five permits in Aquitaine, but Esso has a 70% interest in the latter. Esso Rep is Jersey Standard's 89%-owned French exploration affiliate—with the French holding 11%.

Crude Price Break Seen

A "significant break" in crude-oil prices has begun to appear "inescapable," according to economist Eliot Janeway, president of Janeway Research Corp. Realists in the oil business "are bracing for a cut of as much as 50c per bbl," he said. Decision as to when the break will come "will be determined by the Russians," and "they are dumping so much for so little in so many places that they are on the verge of pushing the oil industry out of a depression into a crisis."

TGT Nigerian Concession

Tennessee Gas Transmission has announced formation of Tennessee Nigeria Inc. to hold a 1,200,000-acre concession on the Gulf of Guinea, east of Lagos, the capital of Nigeria.

Promising Japanese Discovery

A Tokyo press source says Japan's Petroleum Resources Development Corp. has announced a "very promising" oil discovery in the Mitsuke field of Niigata prefecture, northern Japan. Between 1,024 ft and 1,140 ft. output is reported as 200 kiloliters, or 15% of Japan's present daily production. In the same area, the corporation expects natural-gas production of some 3,500 cubic meters per day.

USSR Prospects Good

Professor F. Trebin, chairman of the Soviet State Committee for Science and Technology of the RSFSR, said recently that prospects for the Soviet oil industry are excellent. In the past decade, oil reserves increased fourfold and gas reserves are now estimated at 1,942 to 2,118 trillion cubic feet, or twice the USA's. Due to the high technical level of drilling equipment, further discoveries are to be expected. Drilling depths of 16,400 ft are being mastered; preparations for wells with a depth of 23,000 ft and 32,800 ft are being made. More than 80% of drilling is done with turbines. Trebin also claimed that exploitation methods in the USSR are superior to those in the USA. From 1954 to 1958 some 150,000 wells were drilled in the USA accounting for a crude increase of 12.5 million tons; in the USSR only one-eighth of the wells was drilled during the same period, but crude yield increased by 60.5 million tons. Complete mechanization and telemechanization of production operations have reduced the number of production crews by one-fifth. This year 144 million tons of crude and more than 1,871 billion cubic feet of gas are to be produced. In view of past performances, fulfillment of these plan targets raises no problems, said Trebin.

To Study Australian Oil

The Petroleum Institute of France is starting a long-range study of the possibility of discovering petroleum in Australia. While about 60 companies are searching for oil in Australia and have spent about $135 million, no commercial deposits of oil have been found, the record shows.

The study will start with a one-year study of records of government and oil companies—followed by field surveys of all sedimentary basins and detailed examination of selected areas.

Alaska Pipeline Confirmed

Local officials of Standard of California Western Operations Inc. in Anchorage have confirmed earlier reports that the company will construct a 20-mile 8-in. crude line and marine terminal facilities on Alaska's Kenai peninsula. The $4 million line, to be operated by Kenai Pipe Line Co., a newly formed subsidiary, is scheduled for mid-1961 completion. Initial work on storage facilities at Mikiski, on Cook Inlet, will begin in a few weeks.

Iran's New Test

Iranian Oil Exploration and Producing Co. recently spudded a test in the Pazanun area, along the Agha Jari-Behbahan Road, 18 miles southeast of Agha Jari. The first exploratory well was drilled in 1926. So far, four wells have been drilled, but none has proved successful.

More Soviet Oil for Japan

Second recent contract to be signed by a Japanese firm for import of Soviet oil is by Idemitsu Kosan Co., of Tokyo, for six to eight million tons (42 to 56 million barrels) of medium-quality Baku and Sakhalin crude at a price to be $1.00 to $2.00 a ton below rates for Middle East crude, or average $16 to $17 per ton fob Japan. The price would be lowered further when the projected pipeline between the Baku fields and Siberian ports was completed. Earlier, the New Asia Oil Co. concluded an agreement for 1.5 million tons over a six-year period.

Offshore in Australia

Broken Hill Pty. Ltd. has applied to the Victorian government for oil prospecting permits off the coast of Victoria. The areas are off the Western District coast and in Bass Strait, off Gippsland's Ninety-Mile Beach, extending up to 50 miles offshore.

Norwegian Gas Tax Rises

Retail gasoline taxes in Norway, already about 60% of the retail price for regular-grade, are to rise another 2/3c July 1. Equaling about 53c per US gallon, the retail price includes 32c in taxes.

Austria's Refinery Runs

Austrian refineries during the fourth quarter of 1959 ran 473,509 metric tons of crude to stills (under 380,000 b/d), according to the Assn of the Petroleum Industry.

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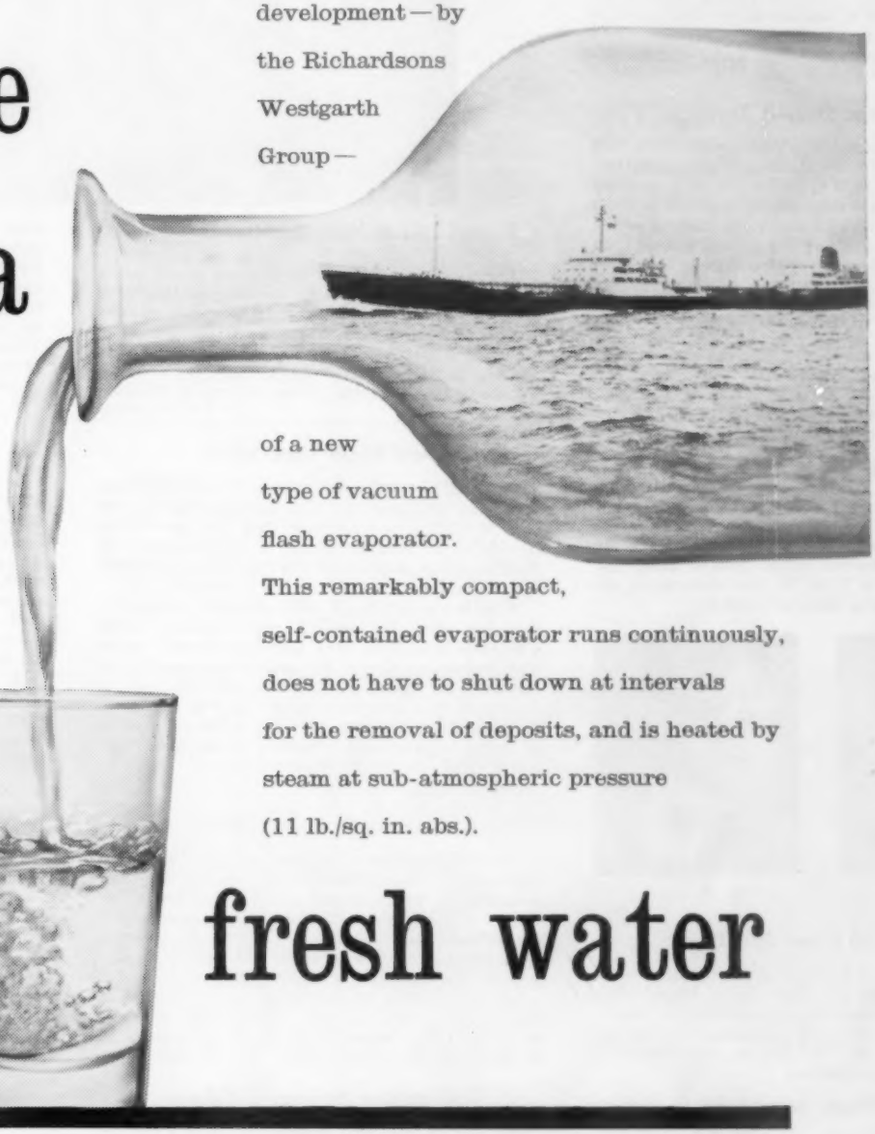
The idea of getting fresh water from the sea by evaporation is not new, but the ability to do so simply and economically dates from the development — by the Richardsons Westgarth Group —



of a new type of vacuum flash evaporator. This remarkably compact, self-contained evaporator runs continuously, does not have to shut down at intervals for the removal of deposits, and is heated by steam at sub-atmospheric pressure (11 lb./sq. in. abs.).

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Fourth Trucial Coast Well

Abu Dhabi Marine Areas Ltd. (2/3 BP, 1/3 Cie. Francaise des Petroles, Paris) has started development drilling on the Umm Shaif structure, east of Das Island in the Persian Gulf, where it has been exploring since early 1958. Three wells have been completed by the drilling barge "Adma Enterprise," and a fourth is in progress.

No. 1 well found oil in the Thamama formation at about 5,500 ft, but results in No. 2 were disappointing. No. 3 was completed after oil had been found in the Araej Zone at about 9,600 ft. Preparations for commercial production have begun, involving construction of a 20-mile submarine pipeline to bring the crude from the field to Das Island. Gas-oil separators will be installed on the island, along with storage tanks and a tanker-loading jetty. This work will take approximately two years to complete.

Austrian Output Down

In the face of rapidly rising consumption (to a level in excess of 50,000 b/d), Austrian crude output declined 13% during 1959 to 45,800 b/d, or a one-third drop in the four years since Austria regained its fields from the Russians. Official reserve estimate as of the beginning of 1960 is about 265 million barrels (38,815,000 tons), against 660 million barrels four years ago.

Start Timor Drilling

Tradewinds Exploration Inc. (partly owned by Sunset International) will begin early drilling on its 4.5 million-acre concession, 500 miles northwest of Darwin, Australia. Information from two earlier wells provided "several very encouraging drilling structures."

Austrians Find Gas

Vorarlberger Erdoel (an Austrian company partly owned by the province of Vorarlbert) near Dornbirn in Austria, close to the Swiss border, has made the first high-pressure gas find in the Molasse basin. The wildcat was taken to 8,141 ft, and encountered the first of two gas-bearing zones at 7,724 ft.

G. M. Bassnett

G. W. Jones

Europe Director for Thew

George M. Bassnett has been appointed director of European operations for The Thew Shovel Co., Lorain, Ohio manufacturer of power shovels, cranes and front-end loaders, and managing director of Lorain-Holland N. V., The Hague, Netherlands, a wholly-owned Thew subsidiary.

New PGAC Subsidiary

Pan Geo Atlat Corp. (PGAC) has established a new French subsidiary company, PGAC Sahara, S.R.L., with headquarters at 65 Abenue des Champs Elysees, Paris.

All types of oil well logging, perforating and other wireline completion services are being performed in the Algerian Sahara area of Edjeleh, south of Tunisia and close to the Libyan border. M. DeMalleray, well known in the French oil industry, has been appointed general manager of PGAC Sahara, S.R.L. Field operations are being directed from Maison Rouge, OCRS, Africa. Robert Ross has been appointed as operations manager for PGAC's Sahara field activities.

McKee & Co. Appointment

Election of William B. Hudson, Jr. as vice president in charge of refinery engineering for Arthur G. McKee and Company has been announced. Mr. Hudson will be responsible for estimating and for the process and mechanical design of petroleum refineries, chemical and petrochemical plants. The position was formerly held by F. Drake Parker who is presently acting as managing director of McKee Head Wrightson, Ltd., in London.

LA Nomads Meet

International guests and speaker are shown at the April 13, 1960 meeting of the Los Angeles chapter of Nomads. From left to right (front row) Stanley Nelson of Stanvac from Sumatra; K. B. Jauman of Comdrill International from Libya; Charles L. Frisch, speaker, of Swissair; T. P. Igo of American Overseas Petroleum from Sumatra; George Murray of Petrobras from Brazil; (middle row) William Hendricks of Arrow Drilling Co. going to London; Fred Peveto of I.P.C. from Iraq; Charles C. Kane of I.P.C. from Oman; Jeff Goddard of Oilfield Supply from Australia; (back row) M. Donald Wagner of Mobil Oil Co. de Venezuela; Frank R. Wilmer of Shell Co. of Venezuela; Mercer Martin of I.P.C. from Iraq; Mitchell F. Stetson of Arrow Drilling Co. going to Turkey.

New Fluid Loss Agent

Extended fractures and deeper sand penetration with water and acid base fracturing fluids are possible now with WAC-8, a multi-purpose fluid loss agent being introduced by Halliburton Oil Well Cementing Co. Fluid retention properties of this Halliburton-developed chemical approximate 20-25 ml in 30 minutes.

WAC-8 was developed when researchers sought a fluid loss agent that would permit fracturing highly permeable formations that had been treated earlier with little or no success. For most formations WAC-8 can block the fracture face temporarily and make it possible to treat with less pressure and reduced pumping horsepower requirements. This is because WAC-8 imparts non-Newtonian properties to the base fluid, which results in greatly improved friction loss characteristics.

Kellogg Appoints Jones

The M. W. Kellogg Co., New York, a subsidiary of Pullman Inc., has appointed Mr. Gordon W. Jones assistant vice president and director of construction. Mr. Jones will be responsible for all construction activities in North and South America and for development of construction methods for world-wide use. His former position was manager of technical services.

Mr. Jones joined M. W. Kellogg in 1929. His first construction assignment was in 1933 as field engineer. In 1955, he was appointed construction manager of the Kellogg International Corp., Ltd., London.

Underwater Storage Offshore

The site for the first offshore underwater storage facilities of its kind has been picked near St. Petersburg beach, Florida. The pilot installation will consist of several collapsible tanks set into special cradles anchored to the ocean floor. The tanks are made of rubber-impregnated and coated fabrics, impervious to the elements. They will withstand hydrostatic pressures, and contents will remain at a mean temperature. The tanks can be used for both civilian and military purposes to contain almost unlimited types of liquid and solid materials. The project is sponsored by Firestone, Global Marine Exploration, and Jet Fuel & Storage Co.

Erratum

Mobil Oil Austria A.G. is erroneously referred to on page 184 of World Petroleum Report-1960 which reviews Austrian operations. It is there stated that Vacuum Oil Co. (Refining) and Mobil Oil Australia AG (Marketing) were merged during 1958 into Mobil Oil Australia AG. This statement is in error. Vacuum Oil Co. (Refining) and Mobil Oil Austria AG (Marketing) were merged during 1958 into Mobil Oil Austria AG.

Tidewater Invests $100 Million

Tidewater Oil Co. plans 1960 capital expenditures of $100 million, according to Tidewater president George F. Getty II. More than half of the capital funds invested this year will be devoted to exploration and production, Mr. Getty said. Manufacturing and marketing will each receive about 17% of the money, and transportation will be responsible for approximately 10%. Tidewater's greatest gain in 1959 was in net income, which totalled $33,941,000, equal to $2.23 per share of common stock.

A significant part of Tidewater's 1959 success stemmed from its ability to hold the line on operating costs and maintain close control of inventories, Mr. Getty revealed. Costs were cut nearly $30 million below 1958 figures, he said.

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Aramco Has Record Year

The Arabian American Oil Co. (Aramco) in 1959 produced nearly 400 million barrels of crude oil, more than in any other year in its history, according to the company's annual report of operations. Aramco's production of crude oil totaled 399,820,590 barrels (53,307,390 tons), or an average of 1,095,399 b/d. This is 7.9% more than in 1958.

Despite the record production, proved remaining recoverable reserves increased to approximately 38.6 billion barrels (company estimate) at the end of 1959, up from 36.7 billion the previous year. Aramco had 201 producing oil wells at year-end, compared with 192 wells at the close of 1958.

Crude oil processed at the company's Ras Tanura refinery increased 3.7% to an average of 174,273 b/d in 1959. During the year the refinery processed 63,609,799 barrels (8,469,109 tons) of crude oil.

Other highlights of the report:

The Khursaniyah field was made ready to go into production in 1960, and the offshore Manifa and the inland Khurais oil fields were further delineated.

A $6.8 million alkylation plant to make aviation fuel was completed at the Ras Tanura refinery. Also in Ras Tanura work began on a new plant to produce refrigerated liquefied petroleum gas (LPG) for offshore sale. This will be the first plant in the world designed and built specifically for this purpose.

The 'Ain Dar Gas Injection Plant, largest in the Middle East, began operation, and by the end of the year was injecting more than 160 million cubic feet of gas daily into the producing structure. Plans were initiated for construction of a $7.4 million plant in Abqaiq to inject 37,000 b/d of LPG into the 'Ain Dar reservoir.

Octanes to Go Up

The average quality of regular-grade gasoline may be stepped up during the coming motoring season. This is indicated by the spread between the best and the poorest quality, which is too large; by the appetite of the new compact cars for high-octane fuel; and by the appearance already of several "regular" gasolines with research octane numbers in excess of 95.

W. A. Anderson

H. A. Olson

Anderson Appointed at Procon

Walter A. Anderson, resident manager of Procon (Canada) Ltd., has been elected a vice president of the Canadian refinery and chemical plant construction company. Mr. Anderson joined Universal Oil Products Co., parent company of Procon, in 1934. UOP specializes in petroleum research. He was transferred to Procon as chief estimator in 1953 and was appointed resident manager of the Canadian company in 1955. His home is at 494 Avenue Road, Toronto.

New Pipe "Prober"

A continuous fluoroscoping process, which reveals any hidden flaws or defects in the welded seams of steel pipe, has been developed by National Tube Co. division of United States Steel Corp. for further quality control. The process is being used at National Works to inspect welds on the large-diameter electric welded pipe which National Tube produces for oil and gas transmission lines.

CB&I Elects Fraser

Edward S. Fraser has been elected vice president-manufacturing by the directors of Chicago Bridge & Iron Co., world-wide steel plate fabricating and construction firm. Mr. Fraser has been in charge of the company's manufacturing operations for the past six months. Previously, he served as assistant general sales manager of the company, manager of its Salt Lake City plant and as an engineer in Chicago.

Bowen Names Export Manager

Hilmer A. Olson has been promoted to the position of export sales manager of Bowen Itco, Inc., a Houston specialty oil tool manufacturer. Mr. Olson, prior to his promotion, had been the assistant export manager. He originally joined the Bowen organization in 1946 upon his discharge from the Army, and has spent the past fourteen years in various phases of the Export Division. Mr. Olson is a member of NOMADS, joined that organization in 1954 while in Los Angeles and transferring to the Houston chapter in 1958. He is also a Major in the U. S. Army Reserve. Mr. Olson replaces Ollie L. Turner who, until his death in Mexico recently, was export sales manager for Bowen Itco, Inc.

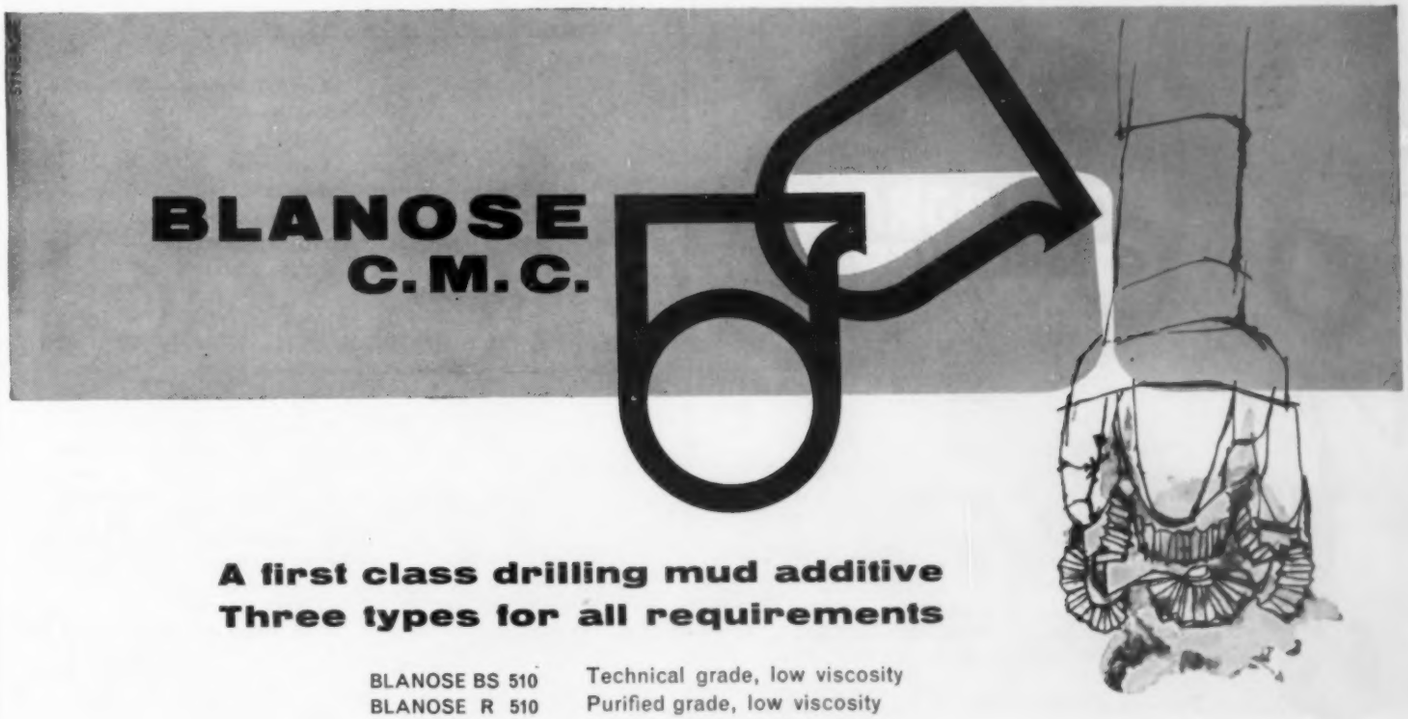
350-Mile Micro-Wave System

Magnolia Pipe Line Co., the nation's second largest pipe line system, has announced plans for a 350-mile micro-wave communication system to link points in central and western Texas. The company is the common carrier affiliate of Socony Mobil Oil Co., Inc.

The network will provide static-free voice communication between the company's major storage terminal at Corsicana and its West Texas gathering terminal at Midland. Both Texas cities are joined by major crude oil pipe lines operated by Magnolia. Midland will eventually be the control point for the pump stations on the 235,000 barrel-a-day pipe line. Three of the stations will be switched to remote control in 1961, the others in 1962.

Dow Office in Italy

Dow Chimica Italiana S.p.A., a newly-formed Italian subsidiary of The Dow Chemical Co. of Midland, Michigan (U.S.A.), has opened a marketing office at Via Larga 31, Milan, Italy. The new office will handle the marketing of Dow products in Italy, Greece and the Near East countries. Anthony P. Cole, S.r.l., Via Isocrate N. 25, Milan, will continue to act as general sales representative in Italy. Roger R. Zoccolillo has been appointed manager of the new sales facility.



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R. E. Wise

M. E. Brooks

G. R. Collins

W. McDivitt

New Lummus Appointments

The election of Maurice E. Brooks, George R. Collins and Ralph E. Wise as vice presidents of The Lummus Co. have been announced.

Mr. Brooks is Lummus' director of engineering. He joined the company in 1940 as a process engineer and has since served as senior process engineer and manager of Lummus' French subsidiary, assistant to the vice president of engineering, manager of production engineering and director of engineering coordination.

Mr. Collins is Lummus' Director of Construction. He joined Lummus in 1935 as Assistant General Superintendent of Construction. Since then he has served as Construction Superintendent, and Manager of Construction of Lummus' New York office. He attended the University of Vermont and New York University.

Mr. Wise joined Lummus in 1945 as a development engineer after previous experience in the petroleum, chemical, and petrochemical industries. He subsequently held the positions of sales and process engineer, Assistant Sales Manager-Europe, Manager of Lummus' French and Dutch Subsidiaries, and European Coordinator. In 1959 Mr. Wise was elected vice president of the Lummus Co. Canada Ltd. He holds the degrees of Bachelor of Chemistry and Chemical Engineering from Cornell University.

Dowell Appoints Hurst

A new position as district technical manager was given R. E. Hurst at a meeting of Dowell district engineers in Tulsa. Mr. Hurst has carried on outstanding engineering work that led to new techniques and well stimulation methods that have made possible the recovery of additional oil from the reservoirs. The challenge to find new oil recovery methods has caused Mr. Hurst to devote much of his time on the search for new techniques and the improvements of others. An outstanding example is the Dowell Frac Guide that has made possible improved results from the formation fracturing process and, incidentally, the recovery of a larger percentage of the oil in the reservoir.

Kellogg Appoints Swanson

The appointment of Mr. Howard P. Swanson as assistant treaturer has been announced by The M. W. Kellogg Co., New York, a subsidiary of Pullman Inc. In addition to undertaking new duties as assistant treasurer, Mr. Swanson will continue his activities as manager of the Tax Department.

$11 Million Oil Swap Loss

Atlantic Refining estimates the oil import control program cost the company $11 million during 1959. Largest part of the loss is from trading oil with other importers to the other importers' gain.

McDivitt Named in Venezuela

Wallace McDivitt has been appointed general manager of Ken de Venezuela. Mr. McDivitt was previously manager of the eastern Venezuela division with headquarters at Anaco. E. P. Bud Hayes, Jr., will be the new resident engineer for Ken de Venezuela at Anaco. A. F. Bud Walden will continue as manager of the western division with headquarters at Maracaibo.

SIE Appointment

Howard S. Gleason has been appointed assistant to the president of Southwestern Industrial Electronics Co., a division of Dresser Industries, Inc. He came to SIE from Stromberg-Carlson, where he was assistant general manager of the electronics division.

New Cummins Diesels

Cummins Engine Co., Inc. has announced three new large displacement diesels for the international market.

The new NHE 180, the NHE 195 and the NH-250, are rated at 180, 195 and 250 horepower respectively. They are especially designed for economy, dependability and long engine life.

Cummins Diesel International Ltd., with headquarters in Nassau, Bahamas, has 206 sales services points in 119 countries throughout the world. In addition to the world-wide network of Cummins distributors and dealers, 16 factory authorized service representatives, located in 12 strategic locations around the world can assist diesel owners and operators in obtaining the most efficient operation from these new Cummins engines.

USA Demand Down

Oil-demand projections for 1960 were trimmed sizably when Chase Manhattan Bank's petroleum division said first-quarter demand in the USA was less than ½% above 1959 "despite weather that was 3% colder than a year ago and a substantially higher level of economic activity." Estimate of increase for all 1960 was cut to 3%, compared with bank's forecast last December of a 5% to 6% gain.

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H. C. Boschen

G. F. Ferris

Raymond International Elects

Raymond International Inc. has announced election of George F. Ferris as chairman of the board of directors and Henry C. Boschen as president. Mr. Ferris succeeds Maxwell M. Upson as board chairman. Mr. Upson, a member of the Raymond organization since 1907, has been chairman since 1946. He will remain on the board of directors with the title of honorary chairman. Mr. Ferris joined Raymond in 1946 as vice president and general manager. He also was elected to the Raymond board at that time. In 1953, he became president.

Kellogg Appoints O'Hare

Thomas E. O'Hare has been appointed as staff engineer-economist by The M. W. Kellogg Co., New York, a subsidiary of Pullman Inc. Mr. O'Hare will be responsible for directing and making economic studies in various fields of Kellogg engineering activity including pulp and paper, chemicals, oil refining, and iron and steel.

Offshore Georgia Rights

For the first time, bids are out for the leasing of oil and gas rights offshore the state of Georgia—following an offer by Pure Oil and a Dallas group. Potential bidders are asked, in the absence of any state map with tracts marked thereon, to specify the location and amount of land, etc.

Parker Heads Geologists

Ben H. Parker, president of Frontier Oil Co., is the new president of the American Association of Petroleum Geologists. He succeeds Lewis A. Weeks, consulting geologist of Westport, Connecticut, who will continue on the Executive Committee of the Society as past-president for the coming year.

Gulf Has New Cement Mixture

A special, new cement mixture has been developed by Gulf Oil Corp.'s technical service laboratory in Houston.

The development is of significant help in drilling through formations so porous they dehydrate cements now in use and cause the cement to thicken and choke off the space between the wall of the hole and the casing.

The new Gulf development consists of a high-gel cement, which contains a high content of clay, with special additives to improve its performance. In addition, one of the mixtures used was lightened by lightweight materials. The compositions are described as low water-loss cements.

Howe Receives Powers Medal

Henry Van Wagenen Howe, professor of geology, Louisiana State University, Baton Rouge, La., has received the Sidney Powers Memorial Medal award of the American Association of Petroleum Geologists at the Joint Session of the A.A.P.G. and S.E.P.M. at the Steel Pier Auditorium. The highest honor of the Society was presented to Howe by President Lewis G. Weeks. The citation emphasized Dr. Howe's outstanding contributions to paleontologic research and the important role that he has played in educating thousands of young geologists through the years.

SSC Elects Hammond

Joe W. Hammond, staff supervisor of foreign operations for Seismograph Service Corp. has been elected assistant vice president of the company.

F. D. Parker

D. H. Carter

McKee Appointment

F. Drake Parker, formerly a vice president of Arthur G. McKee & Co., has been appointed managing director of McKee Head Wrightson Ltd. with headquarters in London, England. Douglas H. Carter was also appointed as director and general manager of the British concern. Mr. Carter was formerly director and general manager of Head Wrightson Processes Ltd.

Dresser's Future Improves

Dresser Industries, Inc. has declared a quarterly dividend of $0.30 payable on June 15, 1960. On an annualized basis, the new rate becomes $1.20 by comparison with the $1.60 previously paid. In commenting upon the Board's action, H. N. Mallon, chairman, stated that some 40% of Dresser's sales volume is associated with domestic drilling, the outlook for which, this year and for the next few years, is not encouraging.

Riddle Heads Supply Men

Ray F. Riddle, Riddle and Hubbell Co., Tulsa, was elected president of the Natural Gasoline Supply Men's Association at the annual meeting in Houston. C. P. Stanley of Dresser Engineering Co., Tulsa, was made first vice president and F. W. Bell of Brown and Root, Houston, second vice president. Mr. W. Gebo of Ingersoll-Rand Co., Tulsa, was made secretary and W. F. Lowe was retained as secretary.

P.L.4. An 80 ft. Express Passenger Launch with Napier Deltic 18-cylinder Diesels recently completed for Shell Tankers Ltd. with a speed of 37 knots, and now in use on Lake Maracaibo.

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ADVERTISERS' INDEX

(Advertising Agencies in Italics)

American Iron & Machine Works Co. Subsidiary American Machine & Foundry Co. — Cover III
Lowe Runkle Company

American Machine & Foundry Co., American Iron & Machine Works Co. Div. — Cover III
Lowe Runkle Company

Associated Electrical Industries Limited, Telecommunications Div. — 79
Taylor Advertising Ltd.

Birkett, Billington & Newton Ltd — 82
S. C. Peacock Ltd.

British Ermeto — 65
A. T. A. Advertising, Ltd.

British Petroleum Company Ltd. — 11
S. H. Benson Limited

British Petroleum Company Ltd. — 60-61
Doremus & Company

California Texas Oil Co., Ltd. — 29
Gaynor & Ducas, Inc.

Cameron Iron Works, Inc. — Cover II
Boone & Cummings

Cape Asbestos Company, Ltd. — 26-27
Taylor Advertising Ltd.

Cities Service Oil Company — 59
Ellington & Company, Inc.

Crose-Perrault Equipment Corp. — 88
Paul Locke Advertising, Inc.

Cummins Engine Company, Inc. — 33
Gotham-Vladimir Advertising, Inc.

Davey, Paxman & Co. Ltd. — 76
Industrial Publicity Ltd.

Dawson & Downie, Ltd. — 78
James Jack Advertising Ltd.

E. I. duPont deNemours & Co. Inc. — 9
The Rumrill Co., Inc.

English Electric Company, Ltd. — 1
Technical Advertising Service

Escher Wyss Ltd. — 71

Ethyl Corporation — 54-55
Young & Rubicam, Inc.

Fifth Avenue Hotel — 84
Daniel & Charles, Inc.

Gardner-Denver Company — 14
The Buchen Company

Garrett Oil Tools, Inc. — 23
Glenn Mason, Cunningham & Associates

Geolograph Company — 86
Lowe Runkle Company

Goodyear International Corporation — 6-7
Kudner Agency, Inc.

Grove Valve & Regulator Co. — 19
L. C. Cole Company, Inc.

Halliburton Oil Well Cementing Company — 34
Glenn Advertising, Inc.

Frederick R. Harris, Inc. — 80

Hercules Tool Company — 69
Keefe Advertising Agency

I. C. I. Heavy Organic Chemicals Division — 28
Clifford Martin Ltd.

Lummus Company — 2, 5
G. M. Basford Company

Manning, Maxwell & Moore, Inc. — 63
Fuller & Smith & Ross Inc.

McCullough Tool Company — 15
Raymond O. Perry, Advertising

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CENTER SEAT FOR OPERATOR — Sitting in seat located directly over center of machine, operator can keep casing lined up perfectly with hole being bored.

REVERSE-O-MATIC TRANSMISSION — With this new type transmission, operator can switch auger from forward to reverse without engine slowdown. No gear shifting.

HEAVY DUTY TORQUE CONVERTER — For full, constant speed and smooth power flow, eliminating up to 90% of shock load imposed on drive train.

The new Crose Road Boring Machine provides the fastest, simplest, most economical way for boring crossings and installing casings up to and including 42" in diameter. Heavy duty torque converter and reverse-o-matic transmission deliver full, constant speed and smooth power flow . . . let you switch auger from forward to reverse without engine slowdown . . . no gear shifting.

The smaller Model RBA Crose Road Boring Machine is still available for casing up to 24".

WRITE CROSE TODAY FOR COMPLETE INFORMATION

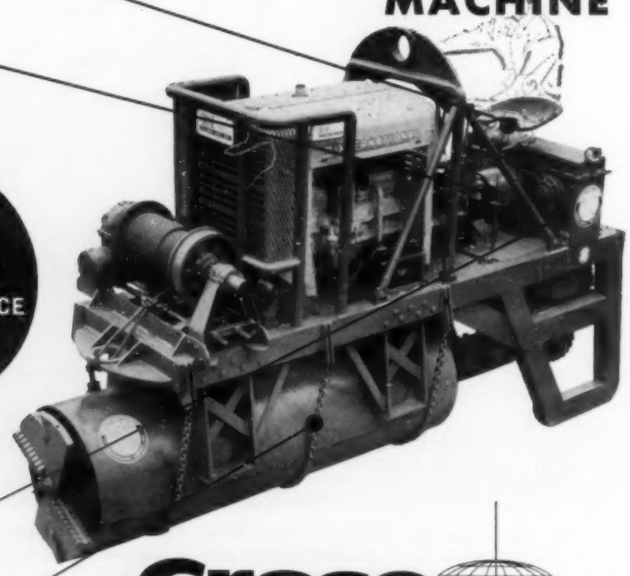
NEW GEAR AND CHAIN BOX — With pressure lubrication feature — has been added to the new Crose Road Boring Machine for greater power capacity.

CASING CLAMP BANDS ELIMINATED — Instead, you use adjustable casing chains which can be easily installed or removed when machine is in ditch.

CROSE

NEW ROAD BORING MACHINE

FIELD-TESTED TOP PERFORMANCE



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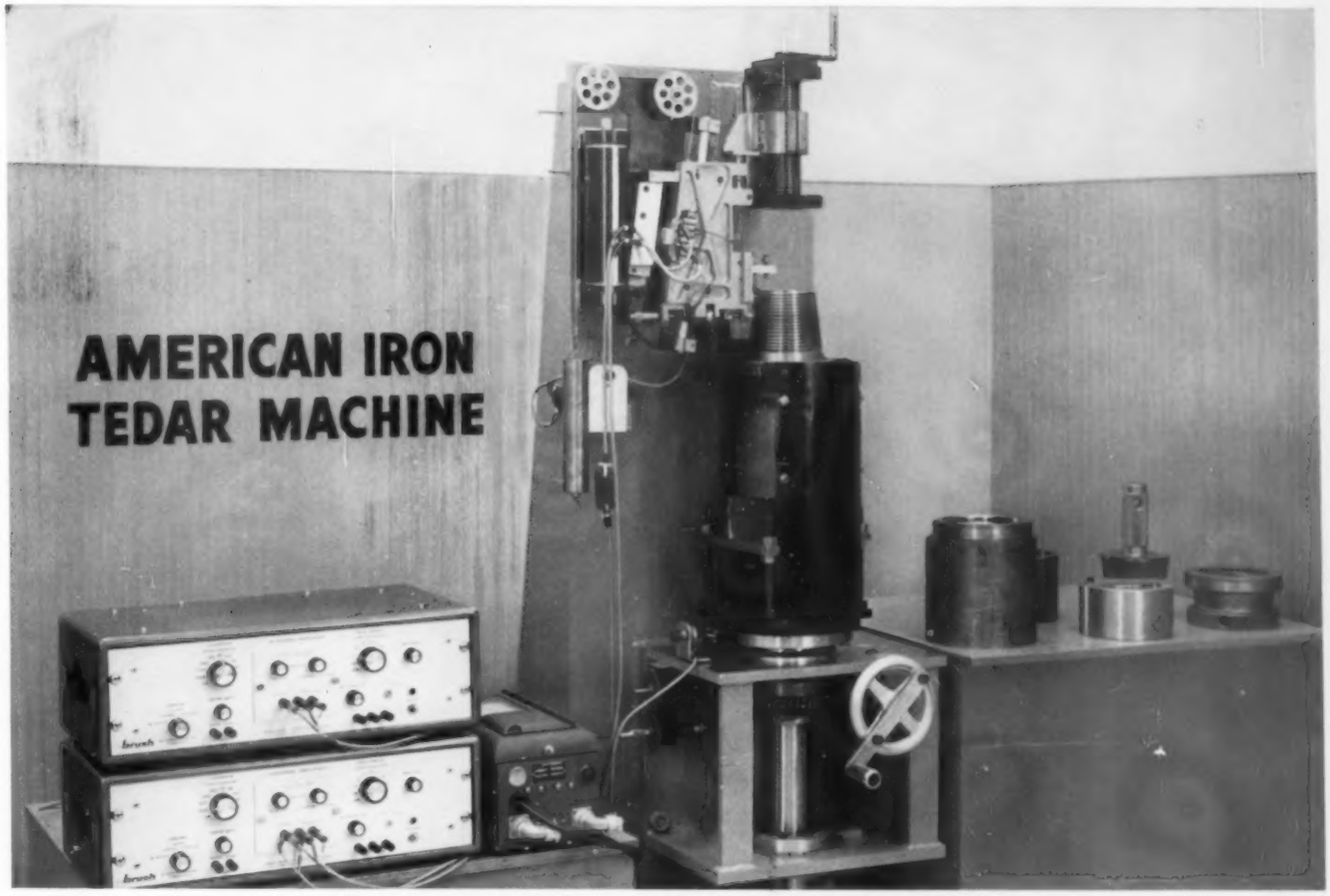

THREAD ERROR DETECTING AND RECORDING MACHINE (TEDAR)

THE ONLY MACHINE OF ITS KIND IN THE WORLD! . . .

Here an engineer is analyzing a recorded chart of a tool joint thread from the TEDAR.

Assures longer service for AMERICAN IRON tool joint threads!

The TEDAR machine, developed exclusively for AMERICAN IRON by a famous research institute, gives minute control of thread gauge accuracy.

Until the invention of the TEDAR, threads were measured grossly by gauges. Now, the actual geometry and dimensions of taper threads are recorded by sensing devices which trace and feel the thread.

These recordings give AMERICAN IRON information previously unobtainable. The result—the manufacture of longer lasting threaded connections through this regulated quality control. This is just one of the many tests used in tool joint manufacturing at AMERICAN IRON.

For longer, trouble-free tool joint service, specify AMERICAN IRON. Available in Straight Grip or Flash Welded, with API or Open-Hole Threads.

TEDAR . . . Another reason why you buy QUALITY when you specify AMERICAN IRON

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The Ultimate in Flexibility for Triple Completions

THE O·C·T TRI FLANGED TREE

There is *no* doubt about the payout when three good zones can be flowed through one wellhead. There *is* doubt when you use a jumble of complicated equipment.

The O-C-T Crescent Flange Tree is tailored for dual completions. And now we are proud to present the "Tri Flanged Tree" tailored for triple completions.

Like the Crescent, the "Tri Flanged Tree" offers the ultimate in *flexibility*, *simplicity* and *economy*. One valve in this triple hookup can be removed without disturbing the remaining two valves. Or, if necessary, any two valves can be removed without disturbing the third.

If there is a multiple producer on your horizon, talk to the O-C-T representative nearest you. He can solve your equipment problems before the problems arrive.

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